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The editors extend a special thank you to Journal of Agromedicine Editorial Specialist Marie Fleisner.

The Socio-Ecological Model

The Socio-Ecological Model (SEM) (Figure 1) is a conceptual framework depicting spheres of

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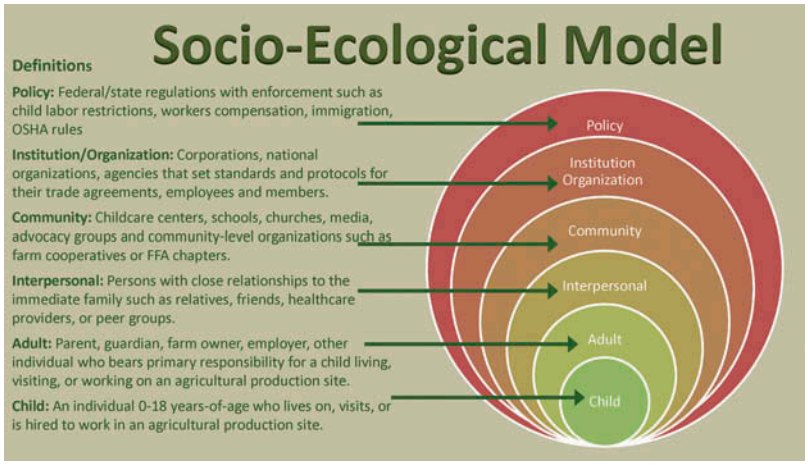

Figure 1. The Socio-Ecological Model (SEM) modified for agriculture.

influence over human behavior that has been applied in public health settings for nearly five decades. A project team modified the standard SEM to address interventions for protecting children from agricultural disease and injury. This framework provides guidance on how a multi-faceted, multi-level intervention can maximize the potential for impact on behaviors and decisions made by parents/adults responsible for the safety of children on farms.

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Think of It Again, Apply It Anew: The Socio-Ecological Model and Farm Safety

Matthew Keifer MD, MPH

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EDITORIAL

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Think of It Again, Apply It Anew: The Socio-Ecological Model and Farm Safety

> "Everything has been thought of before, but the problem is to think of it again." Johann Wolfgang Von Goethe

Those who have passed through the hands of public health educators at some point in their careers any time since the mid-1970s are at least somewhat familiar with the socioecological model (SEM) of health. This model for health, first introduced in the early 1970s through the work of Bronfenbrenner[1] on human development later adopted by the Centers for Disease Control and Prevention (CDC) for various initiatives,[2] attempts to illustrate the interplay between the central character, personal relationships, organizations, regulations, and other environmental factors that influence him/her. For this issue of the *Journal of Agromedicine*, we actively recruited manuscripts from authors who had conducted their research with some influence of the perspective of the SEM in mind or could recontextualize their research within that model. Readers will note various levels of permeation of the SEM in the methodology or presentation of the papers contained herein. At the least, it should be obvious how easily much of the work presented here adapts to interpretation through the lens of SEM. It is refreshing to see this revered standard of public health reapplied creatively and elastically by our contributors. Examples of this include the merging of techniques such as that presented by Bendixsen et al.,[3] who combine SEM with an anthropological technique. On examination, this technique of card sorting closely resembles a virtual mapping of the SEM by various invested observers, such as farmers, agricultural bankers, and agricultural insurance professionals. Additionally, Bendixsen et al. use a nonparametric statistical analysis to explore the similarity of the resulting maps among these different observers, a unique mixture of staid statistical methods to the often purely qualitative anthropological technique. Lee et al.[4] contextualize the findings of their survey of agriculture employers regarding the need for childcare for farmworking families, alluding to the SEM in framing their conclusions. Harrington and Lloyd[5] point out that state policy regarding farm safety training in Oregon, given through the workers' compensation program, fits clearly in the sphere of "Societal." From Australia, Franklin et al.[6] organized their findings from focus groups of farmers and industry representatives of factors influencing farmer behavior into a modified SEM, assessing the strength of influence from various spheres. Prado et al.[7] shift the central figure in their application of the SEM from farmer to farmworker to a study of the factors influencing the underreporting of acute occupational pesticide-related illness. Finally, we see two commentaries by Frank Gasperini[8,9] a fulfillment of long-held aspirations by many who have worked in agricultural safety and health. Mr. Gasperini, the President and CEO of the Agricultural Safety and Health Council of America (ASHCA), as well as CEO for the National Council of Agricultural Employers (NCAE), paints a remarkable detailed verbal portrait of the SEM, when he says

> multiple layers of political and social influence to improve food safety and the well-being of workers including regulations, agricultural trade requirements, business standards/audits, educational endeavors by Future Farmers of America (FFA) and schools, the media, and the expectations of family and peers all exert pressures that will change the way the next generation views the role of public policy on their business.[8]

He also states, more importantly, that the dynamic of the SEM model on the "millennial" farmer will be different than its influence on the current "baby boom" farmer. He points out, "These folks understand that businesses must operate with the permission of, not only government regulators, but with the overall permission of society."[8] Gasperini clearly believes that the next generation of farmers will have a much more accepting, productive, and collaborative relationship with the spheres of the model that surround and influence them.

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This issue of the *Journal of Agromedicine* demonstrates the continuing relevance of the SEM and its versatility in understanding what influences decisions by farmers, farm parents, and farmworkers regarding safety and health. It suggests just what it always has in health and safety, that a deeper understanding of the relative strengths of influence of the different spheres might serve as a roadmap to bringing influence to bear upon central actors, and through the use of trusted advisors, financial dependencies, and regulatory processes we may amplify our ability to bring about safer farming processes and healthier farming populations. This is not a new thought, but as Goethe says, we just have to think of it again.

Matthew Keifer, MD, MPH
Editor-in-Chief

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Breadth of the Socio-Ecological Model

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GUEST EDITORIAL

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Breadth of the Socio-Ecological Model

The socio-ecological model (SEM) was first introduced as a conceptual model for understanding human development by Urie Bronfenbrenner in the1970s and later formalized as a theory in the 1980s.[1–3] The initial theory by Bronfenbrenner was illustrated by nesting circles that place the individual in the center surrounded by various systems.[3] The microsystem closest to the individual contains the strongest influences and encompasses the interactions and relationships of the immediate surroundings. The second circle is the mesosystem that looks beyond immediate interactions and includes those the individual has direct contact with such as work, school, church, and neighborhood. The exosystem does not directly impact the individual, but exerts both negative and positive interactive forces on the individual such as community contexts and social networks. The macrosystem includes societal, religious, and cultural values and influences. Lastly, the chronosystem contains both internal and external elements of time and historical content; in revised models, this level includes the influence of policy.[2] The construct of health was broadly conceptualized in the SEM and focused on the major contributors that might affect health. The SEM states that health is affected by the interaction between the characteristics of the individual, the community, and the environment that includes the physical, social, and political components. The Centers for Diseases and Prevention have adapted the SEM for various health promotion endeavors to include the spheres of interpersonal, organizational, community, and policy.[4] In addition, as the initial model acknowledged the many contributors to human development, subsequent revisions and adoptions use the SEM to represent multilevel approaches to areas such as in public health promotion, violence prevention, healthy college campuses, geriatric preventive health, and colorectal cancer prevention to name a few.[5–8]

As a theory-based framework for understanding the multifaceted and interactive effects of personal and environmental factors, the *Journal of Agromedicine* has chosen the SEM[1–3] to examine a wide breadth of elements that influence and contribute to prevalence, prevention tactics, and evaluation of programming and policy to examine safety in the agricultural environment. Included in this edition, Lee et al.[9] discuss how the SEM was used to frame the discussion of agricultural safety and health interventions.

The SEM levels included in this review seek to be comprehensive with the individual, community, institution, and policy. The articles selected for inclusion in this special issue represent various levels of evidence and are commentary, case studies, program reports, brief reports, and research. Additionally, methodology and theory papers are included. The research endeavors are both qualitative and quantitative, and the geographic areas studied are international as seen in the United Kingdom, Ireland, and Australia. Agricultural safety is reviewed across the lifespan from safety in children to adulthood. Authorship of selected articles is also varied. Represented are university agricultural safety and health programs, university extension programs, state departments of health and human services, as well as individual researchers and research teams. Vulnerable populations are integrated into this edition, illustrated in farmers with disabilities, dairy farmers to migrant workers, pediatricians to adolescents, and intergenerational owners to agribusinesses. The collaborations between industry and individuals to promote safety and the impact of policy on organizational safety are likewise present.

The strength of this special edition is the variety of research methods seen in mixed methods, qualitative, and quantitative studies and the variety of hierarchical levels of evidence-based practice represented as categorized by Polit and Beck.[8] The breadth of agricultural safety topics is wide

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and captures numerous situations and agricultural workplaces. The passion of authors is evident in their desire to improve safety for those who engage in the agriculture workplace. Difficult topics were included, such as the barriers from farmworkers and the under-reporting of acute occupational pesticide-related illness (AOPI)[10] and data that indicated knowledge of required occupational health and safety regulations does not ensure implementation.[11] New fresh information was brought to the agricultural safety stage with two contributions by Gasperini[12,13] where public policy and the next generation was discussed, as well as a discussion on the influence of workers' safety culture as influenced by leaders in agriculture.

With a critical eye, there are also weaknesses in this special edition. Two additional internationally based articles initially selected were unfortunately removed from the dedicated issue due to authors' time constraints for revisions, and, therefore, most articles focus on domestic issues. Some articles share findings from projects that initially were outreach endeavors, then, subsequently generated research questions that were not clearly identified from the projects' outset. Another weakness of this special edition is the research designs selected by the investigators and authors that were often of a descriptive or correlation nature. The levels of evidence-based practice that result from research design are lower ranked, and generalizability is limited. When quantitative, the majority of results are descriptive with means of central tendency. Sample sizes, generally convenient, are mostly small in number, but are seen to range from a low of 9 to a high of 3665. Few articles include a power analysis.

A synopsis of recommendations identified in the selected articles points to the utilization of all levels of the SEM framework to provide guidance to capture the multiple influences that impact agricultural safety. Initiatives from governmental state agencies have been shown to improve the health of agricultural workers, and it was demonstrated that the development of interagency agreements may strengthen programs and injury surveillance.[14,15] There was an acknowledged need to support comprehensive programs that strengthen relationships via networking, sharing information, appropriate legislation, and enhancing leadership, as well as developing best practices in safety management practices.[16,17] To be good stewards of resources, the already created safety curricula need to be promoted nationally and be available for free download shared by multiple agencies, schools, and institutions. Delivering safety messages through existing FFA Chapters and secondary education programs was found to be effective.[18] Additionally, results from one study suggested that mass mailings of injury prevention materials may be a low-cost method of bringing safety awareness to the public.[19] Furthermore, understanding individual characteristics and environmental factors such as attitudes toward safety climate, compliance, and motivation was shown to contribute nontechnical farming skills and can, therefore, guide the development of agricultural safety programs. Examining untapped collaborators, work by Bendixsen et al.[20] stated that agricultural bankers and insures can be good purveyors of safety training. Safety in children was considered within the lens of access to childcare, and findings showed migrant workers sought out employment opportunities based on the availability of childcare.[21] Likewise, a survey of agribusiness owners and human resource directors demonstrated that offering childcare contributed to the value of improved morale and company reputation, as well as providing a more stable workforce, however, many lacked guidance on how to do so.[22] In conclusion, it was noted that in examining safety and well-being the most influential factor in the SEM was interpersonal-organizational.

In summary, authors recommended the dissemination of eligible resources to owners about federally funded migrant health centers, improving toxicology training to health care students and professionals, expanding and strengthening existing programs, and developing interagency agreements to delineate roles and responsibilities for agricultural safety issues. But beyond the learned experience, agricultural bankers and insurers can also represent a positive force in influencing safety decision-making as well as including agribusinesses to support safety of children through appropriate childcare. The creation of social learning in peer groups may be an effective method to increase the adoption of safety standards. And there are untapped resources for promoting safety,

such as rural pediatricians, nurse practitioners, and other health care providers.[23]

Agriculture remains today a dangerous industry, and safety decreases mortality and morbidity. The impact of traditions, culture, research, technology, and policy all influence the interactions and relationships of the nesting circles of the SEM. Within the pages here, future research projects were identified that included exploring partnerships and collaborations that may be found in the levels of the SEM. Authors noted the need for more well-designed and rigorous research in all areas of agricultural safety. This special issue of the *Journal of Agromedicine*, guided by the adapted SEM, brings to the forefront the many facets of the microsystem, mesosystem, exosystem, macrosystem, and chronosystem that contribute to the determinants of agricultural safety.

Jill F. Kilanowski, PhD, RN, APRN, CPNP, FAAN
Guest Editor

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Using the Socio-Ecological Model to Frame Agricultural Safety and Health Interventions

Barbara C. Lee, Casper Bendixsen, Amy K. Liebman & Susan S. Gallagher

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COMMENTARIES

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Using the Socio-Ecological Model to Frame Agricultural Safety and Health Interventions

Barbara C. Lee[a], Casper Bendixsen[a], Amy K. Liebman[b], and Susan S. Gallagher[c]

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ABSTRACT

The Socio-Ecological Model (SEM) is a conceptual framework depicting spheres of influence over human behavior that has been applied in public health settings for nearly five decades. Core principles of all variations of the SEM are the multiple influences over an individual's behaviors, the interactions of those influences, and the multilevel approaches that can be applied to interventions intended to modify behaviors. A project team modified the standard SEM to address interventions for protecting children from agricultural disease and injury. The modified SEM placed the "child in the farm environment" at the core with five interrelated levels (spheres) of influence over the child. This framework provides guidance on how a multifaceted, multilevel intervention can maximize the potential for impact on behaviors and decisions made by parents/adults responsible for the safety of children on farms. An example of how this model could work to safeguard youth operating tractors is provided.

KEYWORDS

Agriculture; safety; socio-ecological model; theory

Background

Occupational safety and health advocates are constantly searching for strategies that offer sustainable interventions that reduce risks of injury and disease. These strategies are often based on education, engineering, environmental, and/or enforcement approaches. To strengthen and potentially measure their impact, they can be based on principles of safety and hygiene, past experience, and sometimes a theoretical model. Agricultural safety and health interventions have lagged behind other occupational safety and public health approaches but increasingly are adopting evidence-based strategies guided by theories and models that have demonstrated success in changing unsafe traditions into safe behaviors. This paper describes how a well-known public health model has been modified for agricultural safety and health to multiply and maximize the impact of agricultural safety interventions.

Introduced in the 1970s, the Socio-Ecological Model (SEM) is a broad-based conceptual model depicting basic ecological principles of human behavior.[1] The SEM has undergone numerous updates and modifications for different applications.[2] The World Health Organization and U.S. Centers for Disease Control and Prevention are among the many users of this model, which illustrates multiple dimensions and complex human interactions that influence behaviors.[3,4] At the core of the model is an individual whose behavior is the primary interest. A figure of enlarging circles added above the core individual demonstrates how spheres of increasing influence have higher degrees of impact on individual behavior (Figure 1). The next level of influence is his/her interpersonal relationships such as relatives, peer groups, or healthcare providers. Following this is the organizational level, which includes organizations, schools, churches, and workplaces. Next is the community level, which represents relationships between organizations. Finally, at the outer sphere of the figure, is the public policy level that includes federal/state regulations with enforcement options. Terminology for the middle levels of the model is

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Figure 1. Socio-ecological model: framework for prevention, centers for disease control. Available from the Centers for Disease Control and Prevention (CDC). http://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.html.[4]

typically altered depending on the user's needs and the model's application.

In an extensive review of various ecological models of health behaviors published in 2008, authors explain that the core principles of an ecological model are: (1) there are multiple influences on an individual's behaviors, including factors at the intrapersonal level, interpersonal level, with increasing influence at levels of organization, community, and public policy; (2) influences interact across these different levels or spheres of influence; (3) use of this model should be applied to specific behaviors; and (4) multilevel approaches can be the most effective interventions for changing behaviors.[5] The evolution of the SEM is based in part on five different theories explaining human behavior, dating from 1951 to 2006, as well as eight different theories used to guide behavior change, dating from 1953 to 2005. The influence of different theorists and their applications of conceptual models over time can explain both the strength and the various visual depictions of the SEM for different audiences.

Modified model

In 1996, the National Institute for Occupational Safety and Health (NIOSH) launched its National Childhood Agricultural Injury Prevention Initiative.[6] As a component of that initiative, the National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) was established to link public and private sector initiatives based upon a national plan of action.[7] In 2014, with two decades of experience, the NCCRAHS wanted to base its current and future endeavors on a theoretical model that would maximize potential impacts. The SEM was chosen as a logical fit for the center's theme of *strengthening public-private partnerships to address childhood agricultural injury prevention*.[8] The model has long-standing acceptance by public health agencies, and it has applications in multiple settings on topics ranging from adding positive nutritional habits and physical activity to avoiding risky practices such as smoking and unsafe sex. To the best of our knowledge, the SEM had not specifically and proactively been applied in agricultural safety and health interventions or program evaluations, nor has it been modified in any specific way to address the well-being of children.

A comprehensive review of childhood agricultural safety interventions conducted by Gallagher in 2012[9] assessed 26 peer-reviewed studies that reported the effectiveness of childhood farm safety interventions. It was determined that most interventions focused on the individual level of the SEM and typically used education as the primary strategy to increase knowledge and influence behavior change. Based upon these findings, the author provided eight recommendations for the future, framed around the principles of the SEM, such as multilevel partnerships; repeated interventions; approaches beyond education (e.g., engineering, policy); diversity in funding; and sustained, widespread dissemination.[9]

A planning team at the NCCRAHS reviewed literature and versions of the SEM and discussed the impact of the spheres of influence relevant to the political, social, and individual environment affiliated with agricultural communities. The team incorporated concepts from non-agricultural projects including experiences using the model for low-income workers.

Our modified version of the SEM (Figure 2) placed the "child in the farm environment" at the core of the figure, with the knowledge that a child (up to 18 years) who lives, visits, or works on a farm is not in a position to change safety practices

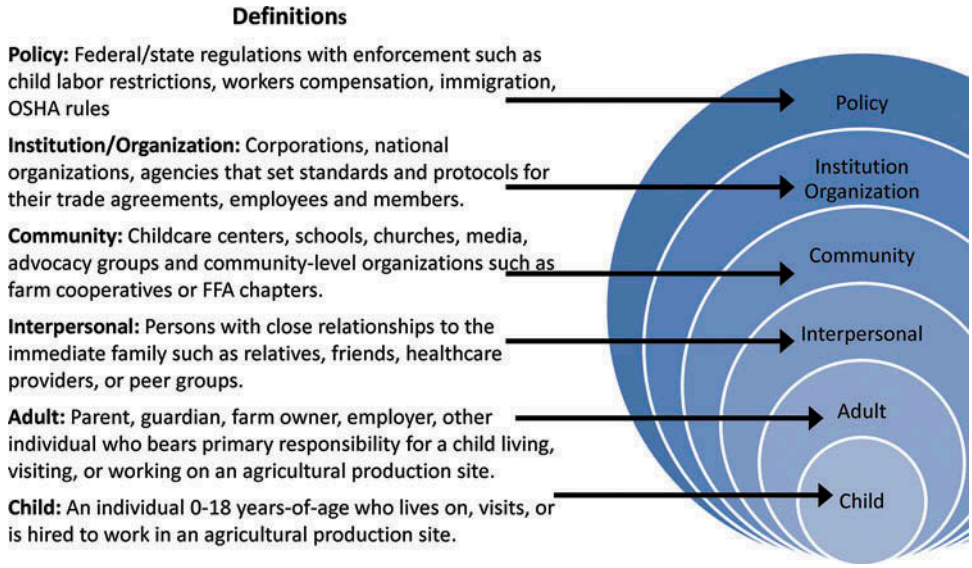

Figure 2. Socio-ecological model modified to address agricultural safety and health interventions.

him/herself. Rather, the focus of interventions is to influence the behaviors of those adults who have the authority and knowledge to reduce the risk of injury and disease affecting children. We believe that all children deserve equal protection from preventable disease and injury, and adults hold full responsibility for safeguarding children under their care.

At the model's core is the child under the influence and protection of the adult(s). There are five spheres with interrelated-levels of influence over the child. The adult sphere includes parents, guardian, farm owners, employers, and any other individual(s) who may have responsibility for youth in the agricultural production site or a farm homestead. The next level of influence is interpersonal—this includes persons with close relationship to the immediate family such as relatives, friends, and peer groups. It can also include health care providers and child care providers who regularly interact with the family. At the third sphere above the child is the community level, which can include local businesses such as farm cooperatives and community-based organizations such as FFA chapters, schools, faith-based groups/churches, and child care centers. At a higher level of influence are institutions and organizations that span beyond the local region. This includes agricultural companies such as property/casualty insurance providers, trade associations, agribusinesses that set standards and guidelines for purchasing agricultural products, national/international trade agreements, bankers and lending agencies, and national media that influence public opinion. The highest level of influence is policy. For the most part, this represents federal and state regulations regarding the role of youth in agricultural work. It can also represent issues such as immigration, federal/state workers compensation laws, and Occupational Safety and Health Administration (OSHA) enforcement standards.

Degrees of influence of the various spheres are subject to many factors. Each superordinate level influences the subordinate level. For example, a public policy may influence a community program that influences an adult to make responsible decisions regarding work assigned to a child living on a farm.

When applying this modified SEM concept to agricultural safety and health interventions, the ideal approach is to have an interrelational link that crosses through as many spheres as possible. We have solid evidence from interventions in non-agricultural settings that a multilevel approach with repeated interventions has the greatest likelihood of achieving the desired outcome. For example, a 2014 report described how the SEM was used in a multilevel intervention to reduce health inequities among low-income workers.[10] Another example is an assessment to propose community outreach interventions to improve

fruit and vegetable intake among inner-city African Americans. Literature was reviewed on past interventions addressing this topic. Relevant interventions were categorized by SEM level then, based upon intervention effectiveness, and recommendations for a multifaceted community-based approach became the basis and rationale for "Best Practices" ecological nutritional programs for African Americans.[11]

Applying the SEM for agricultural safety

What would an ideal intervention based on this SEM concept look like? For explanatory purposes, consider an unsafe practice that puts youth at high risk of an agriculture-related injury. What is the desired behavior change? And what approach could be used at multiple levels to influence the adults that bear primary responsibility for youth involved in that unsafe practice?

Agricultural safety

Equipment manufacturers and safety professionals recommend that all tractors used for production activities include basic safety principles of seatbelts and Rollover Protection Structures (ROPS). It has been shown that this safety standard of a tractor being equipped with a seatbelt and ROPS (or enclosed cab) can virtually eliminate tractor-related fatalities when the operator appropriately uses these safety features.[12,13]

Burden

For youth working in agriculture, tractors are the leading cause of death. An analysis of occupational fatality cases from 2001 to 2013 among U.S. workers under the age of 18 revealed that of the 406 recorded fatalities across all occupations, about 50% of deaths occurred in agricultural jobs, of which nearly all were associated with transportation and equipment.[14] Young workers are often asked to operate tractors that do not meet safety standards, because the older unsafe tractors may be smaller, less expensive, and less complicated to operate, and farm owners do not want young people operating their high-powered, expensive equipment. There are no child labor regulations that mandate safety standards of tractors operated by youth. Further, in the United States, family farms are exempt from child labor in agriculture regulations. In occupational settings, the parent or work supervisor bears responsibility for ensuring that a young worker is safeguarded. However, agricultural work activities can be complicated, making close supervision and oversight difficult to maintain, especially when workers are doing field operations with tractors and trailed implements.

Solution

To minimize the toll of serious injuries and deaths among young workers in agriculture, a solution would be to ensure that youth (14–18 years) who are assigned agricultural work involving tractor operations be allowed only to operate tractors equipped with ROPS, and that these youth be required to wear the tractor seatbelt at all times. Implementing this solution would entail a multilevel, integrated approach that alters long-standing practices and might challenge family and/or cultural traditions. Applying the SEM to a multilevel, integrated intervention would involve each sphere of influence approaching the problem from a different angle, but all with the same desired outcome of improving safety.

The scenario below (Table 1) describes an intervention, based on the SEM, of a national-level campaign to "Safeguard youth operating tractors." The scenario above is an idealistic picture of how the SEM could work, involving entities at all levels of the SEM, and proposing they would agree and engage in a unified way. Realistically, this would be time and resource intensive and difficult to execute. But undoubtedly, if this scenario were set into operation, there could be a profound change that would drastically reduce the toll of injuries and deaths to youth operating tractors.

Implications

Putting the SEM into practice in agriculture is possible. Over the past five decades, much has been learned about the etiology of farm injuries through data on the incidence of injuries and details on changing trends in types of injuries.

Table 1. An intervention, based on the SEM, of a national-level campaign to "Safeguard youth operating tractors."

Policy	Federal child labor laws in agriculture would be changed to set a minimum age of 16 years to operate tractors on public roads and 14 years to operate tractors on private land. The family farm exemption would be eliminated. Federal and state OSHA would establish minimum age limits for all safety standards and would require workers younger than 18 years to wear seatbelts and operate only tractors with ROPS. OSHA standards regarding tractor operations would be enforceable on all farms regardless of number of employees.
Institution/organization	Tractor manufacturers (e.g., via Association of Equipment Manufacturers [AEM] trade association) would publicly announce a position statement that supports the OSHA standard. Agribusinesses would require compliance with federal/state laws and OSHA standards as an expectation of entities from whom they purchase products. National FFA would set a national standard that their Student Agricultural Experience (SAE) ensure youth are in settings where they comply with this safety standard and announce their position via National FFA communication mechanisms that reach advisors, members, and alumni. Other organizations such as the American Academy of Pediatrics would post a position on this safety standard. The national media would publish stories about this national campaign to protect young tractor operators. Media stories of lives saved would begin to shift traditional thinking about guidelines for young people operating tractors.
Community	A comprehensive social marketing campaign would be launched to "Safeguard Youth Operating Tractors." The campaign would be crafted with messages and dissemination strategies based on stakeholder input. Using targeted campaign messages, including social media outlets at the regional and local level, FFA Chapters, schools, and faith-based groups would facilitate efforts of farm owners to ensure any tractors operated by youth are safely equipped. Incentives would be provided by local insurers and bankers, offering economic aid for farmers needing financial assistance to upgrade their tractors operated by youth. These community groups would promulgate the campaign messages and, where appropriate, the position statements issued by national-level organizations. School-based activities would no longer promote "ride your tractor to school" events but would emphasize campaign messages and facilitate tractor safety certification programs. Community-level advocates for the campaign would be trained to deal with controversies surrounding the tractor topic.
Interpersonal	Peer groups, friends, and relatives would share "Safeguard youth operating tractors" campaign materials and openly encourage farm owners and parents to adopt the recommended practices and OSHA standards. These people would reach out to underserved, hard-to-reach farm owners (e.g., niche farms, special populations) with the same information and expectations regarding youth involved in agricultural work.
Adult	Farm parents, farm owners, and employers would acknowledge the multilevel pressure being exerted to change farm practices and comply with the new OSHA standard by not allowing youth to operate tractors unsafely.
Child/youth	Young tractor operators would have strict safety standards set, having access only to ROPS tractors as well as knowing and understanding they are required to wear seatbelts.

Our biggest challenge moving forward is improving safety interventions and taking approaches that will have the biggest impact on reducing the toll of injuries. These multilevel and interrelated interventions have the potential of shifting the "culture" of agriculture to have a greater emphasis on and respect for a "safety culture" in agriculture. It also broadens the general public's perspective on the issue, rather than solely relying on direct interventions by parents or policy-level changes. The diversity of individuals and organizations involved strengthens the capacity to change practices, resulting in lives saved.

Conclusions

Public health demonstration programs have shown us the SEM is a strong and effective way to change individual behaviors by influencing those behaviors at multiple levels. We propose to modify the SEM for application in agricultural safety and health promotion programs. As this model is applied, evaluated, and improved over time, our hope is to have a measurable and sustained improvement in safe practices that create a true culture of safety in agriculture.

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Capitalizing on Federal Agencies' Intentions To Protect Youth Working in Agriculture

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Capitalizing on Federal Agencies' Intentions To Protect Youth Working in Agriculture

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ABSTRACT

Nearly 750,000 youth work on farms across the United States. The U.S. Department of Labor's (U.S. DOL) Fair Labor Standards Act (FLSA) Hazardous Occupations Orders for Agriculture (HOOA) applies to approximately 37% of these youth. The HOOA regulations had not been updated since their inception in the late 1960s and the early 1970s. An attempt by U.S. DOL to update the regulations in 2011 was met with fierce opposition by the agricultural community, and the proposed updated regulations were withdrawn. One impactful outcome of these two events was a rededication by USDA and the farm community to address agricultural youth farm safety through education rather than through regulation. An agriculturally based National Steering Committee has developed consensus Belief Statements and Guiding Principles to proactively influence agricultural youth safety. In this case, USDA was clearly a 'sphere of influence' for youth agricultural safety.

KEYWORDS

Federal agencies; safety consensus; USDA-NIFA; youth safety

The most recent data available suggests there are approximately 2 million farms and ranches in the United States, with nearly 893,000 youth living on these farms and ranches. More than half (51%) of these youth work on their farm or ranch, and over 265,600 nonresident youth are hired to work in agriculture.[1] At the same time, agriculture is recognized as one of the most dangerous industries in the United States, with a work fatality rate of 22.8 per 100,000 workers; this rate is nearly seven times the rate of 3.4 for all U.S. industries.[2]

In a study of fatal occupational injury to youth aged 17 and under using the Census of Fatal Occupational Injury (CFOI) data from 2001 to 2012, Rauscher and Myers[3] found that nearly 50% of the years of potential life lost among all youth were to agricultural youth, and that almost three out of four descendants were working on their family's farm. Sources of injury for both fatal and nonfatal injuries include exposures to machinery, equipment, tools, vehicles, animals, water and other liquids, toxic gases, pesticides and other chemicals, falls from heights, and more.

There are few safety and health regulations in the United States that restrict or limit what young farm workers can do or be exposed to on farms or ranches. For example, the U.S. Department of Labor's (U.S. DOL) Occupational Safety and Health Act (OSHA) does not apply to family members of a farm operation,[4] and their Fair Labor Standards Act (FLSA) Hazardous Occupations Orders for Agriculture (HOOA) applies only to youth under the age of 16 who wish to work for nonfamily employers.[5] Even with this regulation, some exemptions are allowed for 14- and 15-year-old youth who complete educational training requirements. The HOOA have not been updated or modified since they became effective on January 4, 1970.[6]

The U.S. DOL provided funds to the National Institute for Occupational Safety and Health (NIOSH) to review all of its Hazardous Orders based on a review of injury data and scientific literature; NIOSH issued its report in 2002.[7] On September 2, 2011, the U.S. DOL, Wage and Hour Division, using the NIOSH report as a guideline, proposed a massive update to the Child Labor Regulations affecting what agricultural workers under the age of 16 could and could not do for hire.[8] The proposed regulation changes were met with considerable opposition by the farmers, farm organizations, and businesses, and were withdrawn

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on April 2, 2012.[9] Heiberger[10] has provided a summary of the opposition viewpoints.

In the news release by the DOL announcing the withdrawal of the proposed regulation changes, the following statement was made: 'Instead, the Departments of Labor and Agriculture will work with rural stakeholders – such as the American Farm Bureau Federation, the National Farmers Union, the Future Farmers of America, and 4-H – to develop an educational program to reduce accidents to young workers and promote safer agricultural working practices'.[9] It is clear the withdrawn proposed regulation changes have spurred renewed interest by the agricultural community in agricultural youth safety awareness, promotion, and education. Most notably, the U.S. Department of Agriculture National Institute for Food and Agriculture (USDA-NIFA) has reenergized its support of youth farm safety through its Youth Farm Safety Education and Certification (YFSEC) grant program.[11] The initial request for proposals by USDA-NIFA incorporated much of the feedback and concerns expressed by stakeholders in response to the DOL's proposed regulations changes. It specifically noted that the primary purpose of the YFSEC was to develop a coordinated approach to agricultural safety and health education for youth by:

(1) Connecting and enhancing existing educational resources in this area;
(2) Developing a centralized location for relevant training and farm/ranch safety materials for both formal (school) and nonformal (home and ag. industry) settings; and
(3) Developing a national strategy that would enhance awareness of, access to, and utilization of the farm safety materials by youth and adults who instruct and/or work with youth.[12]

The Safety in Agriculture for Youth (SAY) project has been supported by USDA-NIFA since 2013 and currently is in its fourth year of operation.[13] The SAY project, led by Penn State University, is a multi-institutional, public-private, national-level stakeholder-driven initiative that is accomplishing the stated goals of the Departments of Labor and Agriculture upon withdrawal of the DOL's proposed HOOA rule changes. Over the past 3 years, the SAY project has made significant progress in implementing a national approach to YFSEC by: (1) establishing stakeholder groups that engaged experts from various sectors and leadership positions within academia, public health, and the agricultural industry; (2) establishing a National Steering Committee to help identify curriculum and testing gaps, certification needs, and industry-recognized credentials; (3) developing a youth farm safety tool that assesses the alignment of existing youth farm safety curricula with the Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards; (4) developing and implementing a National Clearinghouse for the gathering of national youth farm safety and education curricula and testing; (5) developing online and teacher-delivered OSHA-recognized safety courses for agricultural students; (6) developing a safety protocol for students, teachers, and employers for the Supervised Agricultural Experience (SAE) program; (7) developing a prototype of an interactive 3D farm safety learning activity geared toward youth aged 13–15; (8) conducting a National Youth Farm and Ranch Safety Symposium with key national-level stakeholder groups; (9) working closely with members of the SAY National Steering Committee to develop a national outreach strategy to promote awareness and utilization of the farm safety materials by diverse stakeholder audiences; (10) annually assessing resources required to sustain the Clearinghouse and to continue national dialogue about YFSEC needs; (11) establishing National Young Worker Ag Safety Day; and (12) creating a Youth Safety Zone at the National FFA Conference and Expo. Many of these accomplishments can be reviewed in The SAY 2015 Program Report.[14]

Among SAY's most significant outputs is the development of *Belief Statements and Guiding Principles for Youth Working in Agriculture*.[15] The belief statements outline consensus-based beliefs and principles that promote safety and health for youth working in agriculture, and are intended to encourage parents, employers, agricultural organizations, agricultural educators, agricultural safety and health professionals, healthcare professionals, representatives of underserved populations, and other interested stakeholders, to support and implement them within their own spheres of influence. The seven belief statements are shown in Figure 1.

- Creating and promoting a culture of safety among youth working in agriculture is a primary goal for all stakeholders.
- All youth working in agriculture deserve protection from workplace hazards and risks that may be associated with agricultural worksites.
- Youth developmental principles are the basis for determining if and when a youth should participate in agricultural work.
- Supervision of youth performing jobs or tasks should be guided by professionally recognized best practices based on developmental stages of growth.
- Research and evaluation should guide the development of safety and health best practice recommendations and guidelines.
- Evidenced-based, culturally appropriate models should be utilized to educate about agricultural safety and health.
- Hired youth working on farms subject to Occupational Safety and Health Act enforcement should be informed of applicable rights to a safe workplace, training, personal protective equipment, and to ask questions or raise concerns about their safety.

Figure 1. The seven belief statements developed by the SAY National Steering Committee.

- Parents, employers, agricultural educators, healthcare providers, and safety and health professionals play critical roles in designing and implementing youth agricultural safety education and training that is comprehensive, developmentally appropriate, accessible, and effective.
- College and university agricultural science and education teacher preparation programs should include agricultural safety and health education that meets Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, and/or appropriate state standards.
- Secondary school education and programs should include agricultural safety and health education that meets Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards and/or appropriate state standards.
- Cooperative Extension education and programs should include agricultural safety and health education that is evidenced-based and meets appropriate state standards. Extension educators should consider developing safety and health educational curricula that align with AFNR Career Cluster Content Standards.
- Agricultural worksite hazard assessment programs should be in place, including regularly updated safety checklists, injury prevention programs, and regular review of health and safety best practices.

Figure 2. Five guiding principles used as a basis for "Culture of Safety" initiative by the National Council for Agriculture Education.

These belief statements are buttressed by 14 guiding practices that help parents, employers, and educators operationalize the belief statements. The belief statements and guiding principles are viewable online and in pdf format. To date, 29 national and regional partners have signified their support of this consensus document.[15] Notably, the National Council for Agriculture Education (NCAE) is using five of the guiding principles as a basis for their new 'Culture of Safety' initiative among Team Ag Ed organizations and members.[16] These five guiding principles are shown in Figure 2.

The NCAE provides leadership for stakeholders in agriculture, food, fiber, and natural resources systems education. It strives to surface issues important to agricultural education and stimulate actions to support those issues. The Council serves as a common meeting ground for agricultural education and represents organizations and entities representing students, teachers, teacher educators, state leaders, alumni, industry, and the government. This action by the NCAE will influence the work of Team Ag Ed organizations, such as individual state-level member of the National

Association of Supervisors of Agricultural Education.

One strength of the SAY project is that it is a committed and involved National Steering Committee (NSC). All members represent national-level entities that have a stake in youth agricultural safety and health. Members meet regularly via conference calls, webinars, and in-person. Positive safety messages, and new educational products and activities are communicated by NSC members to their constituent group or members. In-person meetings are facilitated by USDA-NIFA at their headquarters. It is particularly noteworthy that the USDA-NIFA SAY project has brought groups together that have not traditionally been in the same room in discussions of youth agricultural safety. For example, representatives of the federal departments of education, agriculture, and labor have all served on the National Steering Committee. OSHA and USDA both place their logo on a safety certificate that can be obtained via an online agriculture safety course. This was facilitated by a private company partner of the SAY project, which itself represents a breakthrough in approaches to youth agricultural safety.

Also significant is that among those protesting the HOOA rule changes as proposed by the DOL are organizations serving on the SAY National Steering Committee and supporting the SAY belief statements and guiding principles. These belief statements and guiding principles not only have united a diverse group of agriculturalists, but also are currently serving as a framework for bringing additional federal departments and agencies together for collaborative efforts in the name of agricultural youth safety. The SAY Project demonstrates the power of federal agencies to spur positive outcomes from contentious issues by bringing together major stakeholder groups to address important matters. These major stakeholder groups, in turn, influence how their members and constituents move forward on the contentious issue, such as the National Council for Agriculture Education is doing with their Culture of Safety initiative.

For all the good things emanating from SAY, it is too early to know whether this rededication by agriculturalists will last long enough, or be impactful enough, to significantly reduce youth agricultural work injury. This type of success is often measured in decades rather than years.[17] It must be noted that relying almost exclusively upon educational methods is widely recognized as the least effective method of injury prevention.[18] It is also too early to conduct formal evaluations of the educational products or the processes of the SAY Project, but this should be addressed in a few more years.

In the end, whether you felt stymied or elated by USDOL's dropping the proposed updating of HOOA regulations, USDA-NIFA has shown that their 'sphere of influence' is a uniting force for youth safety in agriculture.

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Agricultural Leaders' Influence on the Safety Culture of Workers

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Agricultural Leaders' Influence on the Safety Culture of Workers

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ABSTRACT

Most US farmers are small, independent owner-operators, many of whom are exempt from safety regulation and enforcement, as well as age restrictions relative to family members performing hazardous tasks. These smaller farms account for a disproportionate share of the total fatality and injury statistics from farming incidents, contributing to an agriculture-industry death rate that is seven times greater than all occupations combined. In contrast, large agricultural enterprises that employ larger numbers of non-family workers are more regulated and more highly incentivized by economic, supply chain, and societal factors to implement cultures of safety, and are more readily influenced by agricultural opinion leaders, agribusinesses, farm organizations, and agricultural media. These agricultural influencer institutions must find ways to play more significant roles in changing the culture on operations that use only family labor. They will find willing partners in safety organizations such as the Agricultural Safety and Health Council of America (ASHCA), Agricultural Extension, and other health and safety advocates, including the National Institute for Occupational Safety and Health (NIOSH)-funded agricultural research centers. The overall workplace injury statistics for agriculture remain alarming; however, with leadership from the larger farm operations, and help from ASHCA, academia, the healthcare community, and others, the current culture of workplace safety and health in agriculture can be impacted in positive ways.

KEYWORDS

Agriculture; agricultural leaders; safety; socio-ecological model

Most traditionally dangerous jobs have been increasingly automated and more and more tightly regulated with the resultant increase in safety performance. Meanwhile, agriculture remains a lone bastion with large numbers of independent owner-operators, many of whom are exempt from both safety regulation and enforcement, and age restrictions relative to family members performing hazardous tasks. Thus, agriculture continues to be among our most dangerous occupations with a death rate seven times greater than all occupations combined. Participants in this large segment of US domestic agriculture often have little or no safety training, no safety culture role-models, and have both little incentive and few resources with which to practice on-the-job safety disciplines. In contrast to small agricultural operators, larger enterprises that employ larger numbers of non-family workers are more regulated and more highly incentivized by economic, supply chain, and societal factors to implement cultures of safety, and are more readily influenced by agricultural opinion leaders, agribusinesses, farm organizations, and agricultural media. These same agricultural influencer institutions must find ways to play more significant roles in changing the culture on those operations that use only family labor, including a huge pool of small- and part-time farms.

Larger farms and agricultural enterprises that have hired, non-family employees, increasingly fall under federal, state, and local worker safety and health regulations and are subject to increasing audit and reporting requirements which motivate good business practices and cultures of safety in the workplace. Even regulations not directly related to work-force safety, such as the FDA Food Safety Modernization Act of 2011, have had positive impacts on workplace health and safety by mandating sanitation practices, requiring facilities, and mandating "no non-employees in the workplace" rules which have had the effect of keeping children and other potential bystanders out of harm's way. Additionally, agricultural employers must not only comply with regulations, but their safety performance directly impacts their cost of business in the form of Worker Compensation costs, potential fines or assessments, and potential litigation. These larger

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Figure 1. Agricultural Safety and Health Council of America (ASHCA). Established in 2007 as a not-for-profit association of agricultural leaders, the mission of ASHCA is to *proactively address ongoing and emerging occupational safety and health issues affecting U.S. agriculture*. Since its founding, ASHCA has convened annual conferences and a major National Summit in 2013. Charter members include major agricultural entities such as American Farm Bureau Federation, National Farmers Union, Dairy Farmers of America, Pork Checkoff, National Council of Agricultural Employers, Farm Foundation, CropLife America, and many insurance companies and allied businesses. The NIOSH Agricultural Centers, International Society for Agricultural Safety and Health, and USDA are also among the many members. In addition to ASHCA's safety grants and other program support, its newest endeavor is the AgS HARP™ certificate program to educate and train risk managers of large-scale agricultural operations on best management practices and policies for ensuring safety and health of hired workers. See www.ashca.org for more information on programs and membership.

farms and agricultural businesses are also the suppliers of large retailers, so-called "big-box" stores, and other large food purveyors who do business globally and increasingly require their suppliers to conform with strict ethical codes generally prohibiting child labor, physical or economic mistreatment of workers, overall workplace health and safety cultures, animal welfare, and other sustainability issues as a condition of doing business with them. These large buyers not only audit their producers regularly for compliance, they do not hesitate to debar producers who fail to comply.

In addition to big-box buyers and federal food safety implementation, larger growers that are dependent on exporting their products must also comply with GLOBALG.A.P (http://www.globalgap.org/) and other international or country-specific standards, most of which include broad ethical compliance standards which include on-farm safety, health, and economic equity issues. Because of the need to certify or affirm compliance with such a broad range of official programs requiring health and safety protections for farmers and workers, virtually all large food processors, producers, and marketers require compliance as a condition of doing business with them. Although this directly impacts the larger growers, those 10% of all U.S. farms that produce 80% or more of the food we eat, they also indirectly impact many of the smaller farms because they may produce products to be harvested by larger growers, or sell inputs such as feed and forage to larger producers who must in turn certify that their inputs were produced ethically and sustainably. Between these formal standards in both the United States and globally, combined with increased consumer demand for supply-chain ethics, all growers are significantly more aware of workplace safety and health issues. They are increasingly receptive to efforts of the Agricultural Safety and Health Council of America (ASHCA) and other groups to help them improve and comply.

Several associations that include large producers are working on their own ethics standards which include age-appropriate restrictions and worker health and safety ethics standards. One of these currently underway is a collaboration between United Fresh Produce Association and the Produce Marketing Association which are drafting an "Ethical Charter for Responsible Labor Practices." Many other key agricultural associations were invited as stakeholders in the drafting process, including

ASHCA, which had opportunity to input important wording suggestions into the process. Bottom line for the larger producers—who according to U.S. Department of Agriculture statistics produce nearly 80% of the food we eat although they make up only about 10% of the 3.2 million U.S. farms—is that a combination of regulation, economic, and social requirements continues to move them toward cultures of safety and health due to compliance and business sustainability need.

We expect this trend to continue, facilitating the work of safety organizations such as ASHCA, Agricultural Extension, and other health and safety advocates, including the National Institute for Occupational Safety and Health (NIOSH)-funded agricultural research centers across the United States, and the long-standing National Farm Medicine Center in Marshfield, Wis., which created voluntary guidelines for children's work in agriculture and recently added a publicly available database of agricultural injury news clippings.

The good news is, these larger farm operations also include the largest percentage of the over 2.5 million individuals, including 1.5 million seasonal, who are estimated to be directly employed in production agriculture in the United States. As a result, cultural changes improving occupational safety and health in these businesses will continue to have the fastest and most direct positive impact on people's lives.

The other 3 million-plus businesses classified as farms in the United States range from smaller employers to very small part-time acreages which may never formally employ a nonfamily worker. These very small, subsistence, part-time, non-traditional, and hobby farms will continue to pose significant challenges to those seeking to improve the overall safety and health cultures in U.S. agriculture, and they continue to contribute a disproportionate share of the total fatality and injury statistics from farming incidents each year. These segments are also the most challenging for media, associations, and other safety and health advocacy groups to reach and influence because of their numbers, diversity, and geographical distribution.

ASHCA and other groups continue to network and discuss how to influence this widely diverse group of smaller producers and will seek innovative ways to convince them to adopt cultures of safety in their everyday work lives. Possible avenues include working directly with associations, educators, and publications that may interact more closely with smaller producers including under-served communities, and with specific training or grant offerings tailored to their needs and accessible to them.

The overall workplace injury statistics for agriculture remain alarming; however, we see progress, and we anticipate significant opportunity to instill those cultures of workplace safety and health that are the only long-term solution to agriculture's safety and health dilemma. ASHCA, with the help of academia, the healthcare community, the NIOSH Agricultural Centers, and other groups, looks forward to helping change the current history and culture of workplace safety and health in agriculture in positive ways.

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Public Policy and the Next Generation of Farmers, Ranchers, Producers, and Agribusiness Leaders

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Public Policy and the Next Generation of Farmers, Ranchers, Producers, and Agribusiness Leaders

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ABSTRACT

The emerging, next generation of people engaged as managers in agriculture differs from the "baby boomer" farm generation that relishes certain traditions and an agrarian lifestyle. These futuristic producers and managers have been raised in a society that promulgates safety environment rules. They have witnessed lives saved by automobile seatbelts and lives improved from clean air and water. They know the basic cost of effective safety compliance is relatively fixed, regardless of the number of employees, and they are willing to invest resources that ensure a culture of safety, because it is economically beneficial, socially responsible, and probably required by the companies to whom they need to market their products. These same millennials understand that society and their customers will not continue to tolerate the high rate of agricultural injuries and deaths indefinitely. Public policy as a means to improve agricultural workers' safety and health is likely to be less resisted by the next generation of farmers, ranchers, producers, and agribusiness leaders who, regardless of legal or regulatory pressure, will implement internal business policies emphasizing safety, health, sustainability, and social justness as they understand it.

KEYWORDS

Farm safety; next generation

Domestic agriculture in the United States is experiencing major transitions, and the next generation of farmers, ranchers, producers, and agricultural leaders will view safety regulation and compliance differently. The Socio-Ecologic Model depicts policy as the highest level of influence. The impact of both formal public policy and voluntary practice on society and our environment has been experienced by the younger generation that has grown up with laws about automobile seatbelts, no smoking in public buildings, and airline carry-on restrictions, in addition to the normalization of individual ethics and preferences in environmental practices, human rights, and other ethical causes. Concurrent with these transitions, major buyers and retailers of food and other agricultural products in the United States and around the world are requiring certifications from their supply chain partners of compliance with all legal and specific voluntary ethical, technical, and procedural practices. Growers who will not, or cannot, comply find it increasingly difficult to profitably and sustainably market their products. Younger people, the millennial generation in particular, accept these legal and voluntary "rules" as the norm, and conduct their business operations to comply, because they are widely promulgated and accepted through all levels of influence over their lives. Federal policies have influenced some agricultural practices, and these have primarily impacted large-scale operations and environmental rules. The question can now be asked "Will the next generation of individuals, who have grown up with digital technologies and liberal social/economic policies, be more accepting of both legal and voluntary agricultural regulations and policies that are intended to improve worker safety and health?"

Agriculture finds itself in the midst of a major generational transition of both ownership and management roles as the Baby Boom generation, born 1946 through 1964, reaches retirement or divestment age. According to the Pew Research group,[1] Millennials, born 1991 through 1997, are overtaking Baby Boomers as America's largest generation. According to the US Department of Agriculture (USDA), the average age of a farmer in the United States in 2012 was 58, with approximately 30% of all US farmers being 65 or older.[2] A recent paper by the Nobel Research Institute[3] estimates that about 10% of US farmlands will

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"transition" over the next 5 years. Transition, for individual family farms with few or no non-family employees generally means that either a younger generation of the family takes over management operations, that the farm is rented or leased to another farming entity, or that the farmland is sold. For the larger family farming corporations that now produce approximately 80% of the fruits, vegetables, meat, dairy, and poultry products consumed in the United States, transition usually means management roles at all levels of the corporation being taken over by a combination of family and non-family members as the older generation retires.

Although much common press has focused on very small or start-up millennial farming operations that make up large numbers, the fastest and largest societal impacts are likely to come from very large operations, still predominantly family owned, that produce the majority of both commodity and food, fiber, and ornamental crops in the United States. It is these larger farms, many of whose names can be seen in the fresh foods sections of grocery stores across the United States, that have increasing numbers of millennials in middle and upper management positions being groomed to lead and sustain these organizations into the future. One article recently reported, "From the work that we do, which tends to concentrate on commercial-sized operations, we find that farmers under 44-years-old tend to control farming operations of almost twice the size of older farmers."[4]

There continues to be significant discussion over the future "business health" of domestic agriculture in the United States. While much of the popular agricultural press focuses on concerns of over-regulation, there is also much discussion about the next generation of agricultural leaders and how they differ from those of us who, as aging baby-boomers, are starting to retire in growing numbers. Over the past year, the discussion has continued to grow and widen, particularly among "baby boomer" generation managers of family farming and related businesses relative to their succession plans, passing on their business to the next generation.

As this discussion continues to evolve, one of the most common themes continues to be the fear that millennials will be "regulated out of business." Although discussion can go in many directions, from environmental regulations, to trade policies, to taxation, as well as a plethora of federal, state, and local regulatory challenges, the list of concerns that bubbles to the top includes *safety, health, and environmental regulation and compliance*. Today's economically viable or economically sustainable family farms generally employ at least some hired, non-family workers. Although some in the non-agricultural community may be surprised by this, the reasons are simple; modern economically sustainable farms, those who are producing more than 70% of our nation's food, fiber, livestock, and nursery/ornamentals, are agricultural employers. Of these large farms, 98% are classified as family farms. Due to crops, size, and growing complexity of managing equipment, crops, livestock, and business compliance, these enterprises increasingly employ larger numbers of people, at least seasonally.[5]

As employers, these businesses are not only more legally regulated than the old "family workers only" agricultural producer model, but they must also comply with our society's moral and ethical demands as well to have full and free market access to all the major buying and selling options across national borders. As employers, farms are required to comply with many of the exact same labor laws that any other employer must comply with, in addition to several agricultural specific additions, exemptions, and overlaps. In other words, it is increasingly complex and expensive to be an employer whether you have 10, 20, 50, or thousands of employees. The basic cost of effective safety and health compliance and stewardship is relatively fixed, regardless of number of employees; as a result, the larger employers are generally more able and willing to invest more total resources toward both compliance and practices that ensure a safety culture. One more positive side-effect of this learning and compliance is that the owners, operators, and managers and their families also benefit from the increased emphasis on health and safety.

Over the past 8 years managing the National Council of Agricultural Employers (NCAE), the author has observed what appears to be a general trend in larger family farming operations. More and more of the younger, millennial generation pursue education in hard sciences, business, and

technology instead of, or in addition to, more traditional agricultural degrees. Many work successfully in non-farm settings and/or start their work in the farming operation managing human resources and industrial hygiene, technology, legal/regulatory compliance, marketing, or other not directly production related activities before assuming growing roles in direct management of the overall farming venture. Several large NCAE member family farming businesses require any family member who aspires to senior management roles to have pursued a successful off-farm career for at least several years post university before returning. Having observed several of these Millennial, or younger Gen-X, individuals join the middle and upper management levels of these businesses; it is evident that they tend to manage with a much higher sensitivity that both social-conscience and regulatory/safety compliance are equally important to the long term sustainability of the enterprise as tons, or bushels per acre, hundred-weight of milk or meat produced, or other more traditional measures of day-to-day farming success. These managers, many of whom will replace their elders as leading US farm producers over the next 5 years, are poised to set the example that, we hope, will lead the entire farming and agri-business community to voluntary industry-wide levels safety, health, and ethical-sustainable business practices, which regulation alone may never fully reach.

More important than whether the current level of regulation will grow or decline is the broader discussion of long-term business model viability. The key to long-term farm business survival has more to do with overall business excellence than with simply producing, managing regulations, or maintaining equipment better than the next farm. That means doing EVERYTHING, including how you treat your customers, suppliers, employees, how you get just a tad better fuel efficiency, how you get just a little more productivity from every single thing you do in the operation, how you work safer and healthier, and how you schedule activities just a little better than your competitors.

Long-term business viability and profitability also means being able to determine how best to use the programs available at any given point of time, and then how/when to transition to better alternatives, including figuring out how to employ more technologies. Mechanization includes both equipment and computerization/communication technologies so that record-keeping and documentation are not only done faster and more efficiently but also more accurately and more quickly pulled up when needed for analysis or regulatory audit. Safety in every single part of the business operation is a critical part of that. Remember United Parcel Service (UPS), DuPont, Exxon, and many others became "Number one" in their respective industries, and remain profitable today because of safety, technology, and adaptability, while hundreds or thousands of their competitors have come and gone. No business, even the family farm, can ever be considered excellent without a comprehensive, sustained culture of safety.

The next generation of owners, managers, and leaders emerging in farming and agricultural business understand all of this. They already live it. When I see farms right now where the next generation is coming of age and taking over management, I see folks who do not abandon the basics of good agricultural practices, but who also understand that their business IS A BUSINESS, and not merely a way-of-life or a lifestyle. These folks understand that businesses must operate with the permission of, not only government regulators, but with the overall permission of society, and that no business is guaranteed survival, but if they are providing essential or wanted goods and services, they will be among those who do survive and thrive long-term. They not only understand, but agree with the social responsibility and social ethics standards that large buyers are putting into place. They also understand that safe and healthy workers are both more loyal and more productive. This is not only age-related, by the way; there are older baby-boomers who understand that, too. However, the millennial generation of business owners were raised in a socially conscious world, and it comes more easily to some of them.

There may be no future for producers producing exactly the same things we produce now, the same way we do it right now, but there certainly must be a bright future for those who figure out how to produce the agricultural products that the younger generation wants to eat just a little more efficiently and socially acceptable than the operation next door.

And that efficiency and social acceptability can only thrive in a business where there is a complete culture of agricultural health and safety practice at work, every minute of every day.

Although we may well look back fondly on many agricultural practices, traditions, and lifestyles of the past; the next generation of farmers, ranchers, dairymen/women, nurseries, and other agri-business people will not tolerate the current rates of injury and death on the job. Neither will our society, including buyers and the public. The next generation of agriculturalists will change that, and their businesses will thrive as a result.

The multiple layers of political and social influence to improve food safety and the well-being of workers, including regulations, agricultural trade requirements, business standards/audits, educational endeavors by Future Farmers of America (FFA) and schools, the media, and expectations of family and peers all exert pressures that will change the way the next generation views the role of public policy on their business. Let's hope that this option is used wisely and in combination with substantial input from those who are committed to the ongoing contribution of domestic agriculture in the United States as a world leader in food production.

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Sorting Through the Spheres of Influence: Using Modified Pile Sorting to Describe Who Influences Dairy Farmers' Decision-Making About Safety

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Sorting Through the Spheres of Influence: Using Modified Pile Sorting to Describe Who Influences Dairy Farmers' Decision-Making About Safety

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ABSTRACT

Objectives: The primary goal of this study was to describe the mutually perceived influence of bankers and insurers on their agricultural clients' decision-making regarding health and safety. Methods: Semistructured interviews were conducted with 10 dairy farmers, 11 agricultural bankers, and 10 agricultural insurers from central Wisconsin. Three of the interview questions involved pile sorting. Pile sorting included 5-point Likert-like scales to help participants sort through 32 index cards. Each card represented an individual or group that was thought to possibly affect farmers' decision-making, both generally and about health and safety. Results (photographs of piles of cards quantified into spread sheets, fieldnotes, and interview transcripts) were analyzed with SAS and NVivo. Results: All three groups expressed moderate-to-strong positive opinions about involving agricultural bankers ($x2(2) = 2.8155$, $p = 0.2695$), although bankers qualitatively expressed apprehension due to regulations on the industry. Insurance agents received more positive support, particularly from bankers but also from dairy farmers themselves, and expressed more confidence in being involved in designing and implementing a farm safety program. Conclusion: Agricultural bankers and insurers can influence individual farmer's decision-making about health and safety. Both are believed to be good purveyors of safety programs and knowledge, especially when leveraging financial incentives. Insurance agents are thought to be more critical in the design of safety programs. Insurers and bankers being financially tied to safety programs may prove both positive and negative, as farmers may be skeptical about the intention of the incentives, making messaging critical.

KEYWORDS

Dairy; Health Belief Model; mixed-methods; pile sorting; Socio-Ecological Model

Introduction

Approximately 90% of farms in the United States are small family farms with less than $250,000 in annual sales.[1] With limited funds and often exempt from certain safety oversights (depending on the state), owners of small family farms often ignore or grapple with accommodating the safety needs of their farm.[2–6] Two eras have characterized safety efforts to ameliorate risk on farms. Prior to the late 1980s, agricultural health and safety largely resided in the realm of engineering.[2] Then in 1980, the National Institute of Occupational Safety and Health (NIOSH) "recognized agriculture as one of the highest risk sectors for occupational fatalities in the United States."[7] In fact, Public Law 101–517 in the 1990s defined farm safety as "a public health concern to be addressed by the traditional public health approach of surveillance, research, and intervention."[8,4] The move marked a shift in the federal government's approach to agricultural health and safety. Public health began to assume a larger role in addressing the risk posed by farm exposure.

Generally, public health interventions are education based, often identifying the farmer as the object of intervention. The Health Belief Model (HBM) (see Figure 1) is a longstanding source for intervention design. Many later models were built upon HBM.[5] The model, when interpreted in the context of agricultural health and safety, describes how demographic factors (age, gender, ethnicity, personality, etc.) influence a person's perception of his/her susceptibility to injury, the benefits and

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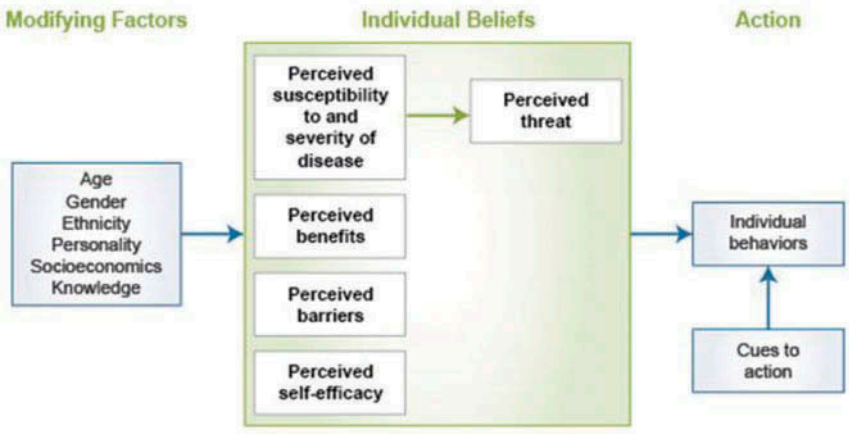

Figure 1. Health Belief Model (HBM).

barriers of engaging in safety behaviors, and the person's self-perception in practicing the behaviors. In combination with how the individual perceives the threat of injury, these concepts constitute the array of "individual beliefs." Individual beliefs with cues to action are thought to influence the behaviors a person engages in, according to HBM. A cue to action spurs the individual "to adopt the preventative behavior by some additional element"[10] or is "exposure to factors that prompt action."[11] These cues can be external, "such as a mass media campaign, social influence…events, people, or things that spur people to change their behavior."[11] One study used recommendations from a health care provider as a cue to action for HPV vaccination.[12] Thus, HBM incorporates the environment, particularly the social environment, through cues to action. Here, the research team endeavored to learn more about the community around central Wisconsin dairy farmers and their ability to influence their decisions and actions.

For example, even an experienced farmer may not recognize the susceptibility and severity of a rollover on a tractor without a rollover protection structure (ROPS). Thus, he perceives the threat of a tractor rollover as low because he has ridden on a tractor without ROPS for many years. In accordance, he does not perceive the benefits of a ROPS as particularly high. If he struggles financially, it increases the barriers to fitting his tractor with a ROPS. Given this scenario, this farmer would likely have low self-efficacy to fitting his tractor with ROPS. Perhaps, farmer's insurance agent reminds him of the dangers of a tractor without ROPS (cues to action). Many times, the concept of social cues (i.e., the environment) is not included when HBM is applied in practice.[13,14] For example, Anderson, Velez, and Anderson documented how agricultural students perceived themselves as more susceptible to welding injury. However, students viewed safety behaviors as not beneficial in preventing welding injuries and rated low on measures of self-efficacy in employing such behaviors.[13]

In a systematic review of HBM in public health programs, Jones, Smith, and Llewellyn state "cues to action was least likely to be addressed in the interventions."[15] In a meta-analysis, Carpenter (2010) concurred that cues to action "is the most underdeveloped and rarely measured or researched element of the model…it is not examined in the current review, as there are not enough studies that measured it."[10] Thus many public health programs ignore the potential influence of the environment on behavioral change. Even the concept of social cues provides an incomplete picture of the environment as a whole. Such cues to action are likely to be temporary (a verbal caution or an informational poster in the workplace) and not attend to a systemic and holistic definition of environment. Thus, educational programs risk excluding important actors in a farmers' environment to provide important social or material reinforcement for safety behaviors. Education may not be retained, particularly when only delivered to employees/farmworkers, and may not be feasible in a given environment due to financial constraints, lack of equipment, or other resources. Thus, more effective interventions could include a greater or more

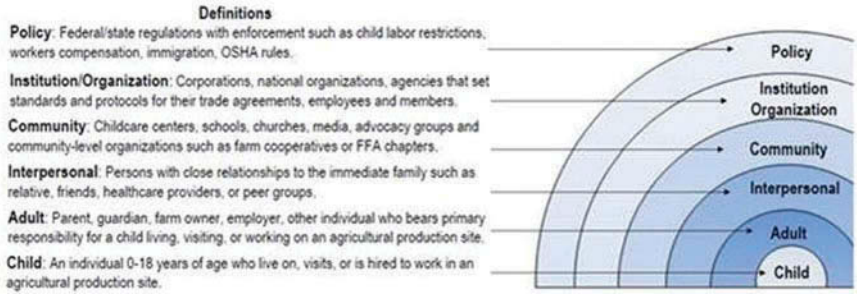

Figure 2. Socioecological model (SEM), modified for agriculture.

nuanced concept of the environment, particularly the social relationships of farmers, such as agricultural insurance agents and bankers.

Furthermore, research to demonstrate safety interventions employed on individuals known by and socially close to farmers or farmworkers remain largely unexplored. The Socio-Ecological Model (SEM), in contrast to HBM, focuses exclusively on the environment. Intervention within the so-called spheres of influence of a farmer may target the level of the interpersonal and community levels of the SEM (see Figure 2)—i.e., within the organizations and individuals with personal or business relationships with farmers. SEM and spheres of influence models (used interchangeably here) can assist intervention researchers and practitioners understand how individuals and institutional forces affect their health population.[16–19] Such individuals and institutions constitute not only an important part of the social environment of a farmer, but also a more pervasive and permanent fixture on the social landscape. Put another way, how could concepts like cues to action within HBM be better integrated when examined through the lens of the SEM and the spheres of influence? How would the interventions that follow include a broader, more holistic concept of the environment?

Anthropologists endeavor to connect macrolevel forces (interpersonal, community, and policy levels in the socioecological model) and structures to the everyday behavior of individuals as SEM theorizes. Thus, the labor of an anthropologist is useful in understanding ways in which friends, family, and community (i.e., the environment and cues to action) ultimately end up impacting whether or not individuals engage in safety behaviors. Anthropological methods provide a means to understand exactly how these individuals are situated in the life of a farmer and how they exert their influence. Unlike the approach historically taken by engineering or public health, anthropology allows the perceptions so heavily emphasized in the HBM to be privileged, and theoretically increasing the likelihood of successful adoption of behavior change.

In order to capture the wide array of people that interact with farmers at the interpersonal and community level of the SEM, the team developed an interview instrument that included semistructured questions and pile sorting. Pile sorting is a common method in psychology and social sciences.[12] The use of cards in pile-sorting tasks is often associated with cognitive mapping and is useful for giving structure to what seems like abstract concepts. For example, pile-sorting methods (also known as card sorting) combined with interviewing strategies have been recently used to measure criminal offenders' beliefs in "redeemability,"[13] analyze adolescents' thoughts of self-worth and self-harm,[22] characterize the influence of caregivers' appraisal in dementia patients' safety,[23] determine the consensus of medical students' understandings of supervisors' comments on their clinical narratives,[24] conceptualize teens' asthma symptoms and their self-management responses,[25] measure how acute stress impairs cognitive flexibility in men more than women,[26] and explore the causes of farmer suicide in India.[27] In contrast to surveys, which also commonly measure peoples' behaviors, attitudes, and beliefs, pile-sorting is more interactive providing additional qualitative data and reveals connections between individuals at the community level. For example, participants often pick up and discuss

individual cards and provide justifications for their placement. This provides depth beyond a written survey and more efficiently than an oral survey.

Preliminary research

Prior research with agricultural bankers during the winter of 2013 and 2014 provided the impetus for this project. The research team was connected to a seasoned agricultural banker with his own agricultural background. His passion for agricultural health and safety as a risk management issue led to his premise that bankers could be more influential in farmers' decision-making about health and safety on their operations. This person became a key gatekeeper and consultant during the larger project. Prior to the submission for funding, this gatekeeper allotted the research team space and access to do interviews and observations at a Wisconsin agricultural bankers' conference. Over the two day meeting, a researcher queried with roughly 80 agricultural bankers whether they valued farm health and safety and whether they felt they could incentivize change on the farms in their portfolio. Researchers sensed that bankers had interest, but felt they had lower capacity to influence than insurance agents. They often cited federal and state laws governing loan giving processes as a primary reason. Given the agricultural bankers interest in health and safety and their common belief that insurance agents could be influential as well, the team pursued the topic further to pursue the pilot project being reported on here.

Methods

To reveal more about the community of influential relationships surrounding farmers, pile sorts and semistructured interviews were conducted with 10 dairy farmers, 11 agricultural bankers, and 10 agricultural insurers from the central Wisconsin region. The region included a 7 county area (Adams, Clark, Jackson, Langlade, Marathon, Portage, and Wood counties). Bankers and insurance agents likely serviced farms outside these counties. Agricultural bankers and agricultural insurance agents were defined as those whose portfolio was at least half agriculture. These professionals were chosen as the focus given their financial investment in the success of their clients' farms. However, as will be shown, a number of different individuals and institutions can be influential of farmers' decision-making. The study was reviewed and approved by the Marshfield Clinic Research Institution's Institutional Review Board.

Prior to research activities, one to three advisors representative of each group were recruited to assist in the development of the pile-sorting and interview instruments. Advisors were not included as research participants. These advisors reviewed possible cards and interview questions. Advisors also assisted in participant recruitment conducted through snowball sampling.

Three of the interview questions were framed as pile-sorting prompts, asking the participants to sort 32 index cards. On each card was written an individual or group that was thought to possibly affect farmers' decision-making, both generally and about health and safety. Three of the pile-sorting prompts included 5-point Likert-like scales. The pre-established scales eased some of the burden for the participants and provided researchers with additional quantitative data. All Likert-like responses were assigned scores of 1–5, 5 being favorable in terms of possible influence that person or institution may exert on farmers' decision-making whether it be measured by time, knowledge, or trust. It is important to note that farmers, agricultural bankers, and insurance agents were the study participants as well as individual index cards. In other words, they were asked to rank themselves during pile-sorting activities. The initial analysis (presented here) focuses in on how the three participant groups (farmers, agricultural bankers, and insurance agents) rated themselves and each other. Future manuscripts will focus on the application of the methods to developing public health interventions and the full results of all 32 cards. Interviews ranged from 45 to 80 minutes; time variability was largely dictated by the amount of detail research participants shared as they placed cards into piles. Results (photographs of piles of cards quantified into spreadsheets, fieldnotes, MP3 audio recordings, and interview transcripts) were analyzed with SAS (SAS Institute Inc., Cary, NC) and NVivo. Nvivo is a qualitative analysis software program that allows users to identify common themes and code data.

The research team consisted of the principal investigator, two research associates, two MPH student interns, and a biostatistician. Research activities were conducted from summer of 2014 to fall of 2016. Three research team members with a background in farming initially formulated a draft of the interview questions and 60 possible cards. Three consults were conducted with farmers to field test the questions and cards. Farmer-advisors suggested changes to wording and helped reduce the number of cards to 32, a process that included consolidating, omitting, and adding cards (see Figure 3). Per most pile-sorting instruments, this process was essentially the free-listing stage.

The interview instrument used with farmers began with three demographic questions regarding the size of their dairy operation, how many people worked on the farm, and how they utilized their acreage. These questions were useful for easing the farmer into discussing their operations and revealed features of the farm that might explain why some people are more influential than others. For example, more or less milking cows per acre used for crops might explain why a veterinarian is more or less influential than an agronomist. Bankers and insurance agents were asked demographic questions regarding the amount and kinds of agricultural clients, their years of experience, and whether farm injuries and deaths had impacted their business.

1. Accountant
2. Agricultural Health and Safety Experts
3. Agricultural Banker
4. Agricultural Media
5. Agronomist
6. Attorney
7. Barn/Milk Inspector
8. Breeder
9. Calf/Heifer Grower
10. Consumer
11. Dairy Farmer
12. DNR/EPA
13. Extension Agent
14. Field Rep
15. Firefighter/EMT
16. Hedge Broker
17. Herdsman
18. Hired Help
19. Hoof Trimmer
20. Immediate Family
21. Insurance Agent
22. Local News/Media
23. Medical Professionals
24. Milk Cooperative
25. Nutrition Consultant
26. OSHA
27. Peer Group
28. Professional Associations
29. Spouse
30. Tourist
31. USDA
32. Veterinarian

Figure 3. Individuals and groups written on individual index cards in pile-sort instrument.

Following the opening line of questions, the pile-sorting prompts began for all three groups. Farmers were first asked, "How often do you talk with these people?" The Likert-like scale to assist participants' sorting included categories of: daily, weekly, monthly, yearly, and hardly ever. After all the cards were sorted, follow-up questions were asked regarding why some people and groups were spoken to so often or seldom. Agricultural bankers and agricultural insurance agents were asked to sort the cards according to "role they play in the success of a dairy farm." This was occasionally clarified to mean the financial success of the dairy farm. The Likert-like scale to assist both groups with this question consisted of the categories: critical to success, advantageous, neither critical nor impeding, can be harmful, and impedes success. Participants were asked to think aloud while they placed cards into categories. Thus, the method produced more in-depth data than if they had independently completed a survey. Digital photographs were taken of the sorted cards. Cards were then collected and reshuffled after each question.

Follow-up questions for the initial pile-sorting prompts of both bankers and agents probed why some people and groups were considered so important to a successful farm and why others impede success. The questions allowed researchers to investigate the role of other parties in dairy farmers' daily lives. These questions also provided more depth around how substantive each actor's role was in the financial and general success of a farm. The question for dairy farmers generated lists of actors most involved in the daily operations on a farm.

The second pile-sorting question for all three groups queried who was thought to have knowledge about farm safety and who would be capable collaborators in designing a farm safety program. Emphasis was placed on the design of a farm safety program and not its implementation. Likert-like scales provided participants with categories of responses that included: know the danger and how to prevent it; know the danger and how to be cautious; know to be cautious but are unaware

of specific dangers; no knowledge of danger or caution or; reckless.

The third pile-sort questions prompted participants to sort cards according to which person or group would do best at delivering and implementing a farm safety program because of the trust established between them and the farm community. The initial question was edited after the first four participants to improve clarity. The phrase, "In terms of how quickly you would make changes," was added to the question "how much do you trust these individuals/groups?" The addition reflected necessary explanations provided to the initial four participants and are not expected to differentially bias the data of the dairy farmers. Likert-like scales for this pile-sorting question included: change as quickly as feasible; change eventually; change after further consultation with other people; not likely even with other consults or; skeptical about the truth and will not make a change.

Numerical values were assigned to the categories on the five-point scale where a low score (1) indicated lesser elements of trust, knowledge, or involvement on the farm and a high score (5) indicated greater elements of trust, knowledge, or involvement on the farm. Kruskal–Wallis tests were performed to evaluate the overall differences in the three groups across all items and for select individual cards/items. If the Kruskal–Wallis test achieved at least marginal significance for a particular card/item, pairwise comparisons between groups were undertaken by performing exact Jonckheere–Terpstra tests.[28] These tests revealed when agricultural bankers, insurance agents, and dairy farmers were agreeing (or disagreeing) about the relationship and possible role a person or an institution could play in the health and safety of a dairy farm. In addition, qualitative data collected during the interview and pile sorting activities provided further depth and detail as to the content and nature of the relationship between the individuals and institutions.

Results

Ten dairy farmers, 11 agricultural bankers, and 10 agricultural insurers from the central Wisconsin region participated in the study to rank 32 cards in three pile-sort questions. Participants also answered open-ended questions and were asked to think aloud while sorting the cards. Again, this included cards that had "dairy farmer," "agricultural banker," and "insurance agent" written on them. That is, participants were asked to rank or sort themselves in each pile-sorting exercise. In total, pile-sorting activities resulted in 2,976 data points.

Comparing the three participant groups across all items

A Kruskal–Wallis test indicated that differences between the three groups of participants were present in their composite responses (i.e., sum of Likert responses for the 32 cards) on designing a farm safety program ($p = 0.07$) (Figure 4). Pairwise comparisons revealed a significant difference between dairy farmers and bankers ($p = 0.02$, exact Jonckheere–Terpstra test) and a marginally significant difference between bankers and insurance agents ($p = 0.10$). No differences in composite responses were detected between the three groups with respect to implementing a farm safety program ($p = 0.52$).

Bankers, insurers, and farmers believe that bankers are not critical or harmful to the design of farm safety program (see Table 1). Insurers were more confident in their own ability to assist in the design of farm safety programs (mode = 5, necessary to the design of a farm safety program) compared to bankers gauging their own ability (mode = 4, helpful).

The agricultural banker item/card

Among the three groups of participants, agricultural bankers and insurance agents most closely resembled each other regarding the potential role of agricultural bankers in designing and implementing a farm safety program. Dairy farmers were slightly less confident in the role of a banker on a farm safety program. Ultimately, the three participant groups did not differ significantly ($p = 0.27$ for design and $p = 0.25$ for implementation of a farm safety program).

Qualitative data support and deepen the quantitative results. Bankers reported being encumbered by regulation, restricting their ability to design or implement a safety program. One banker explained,

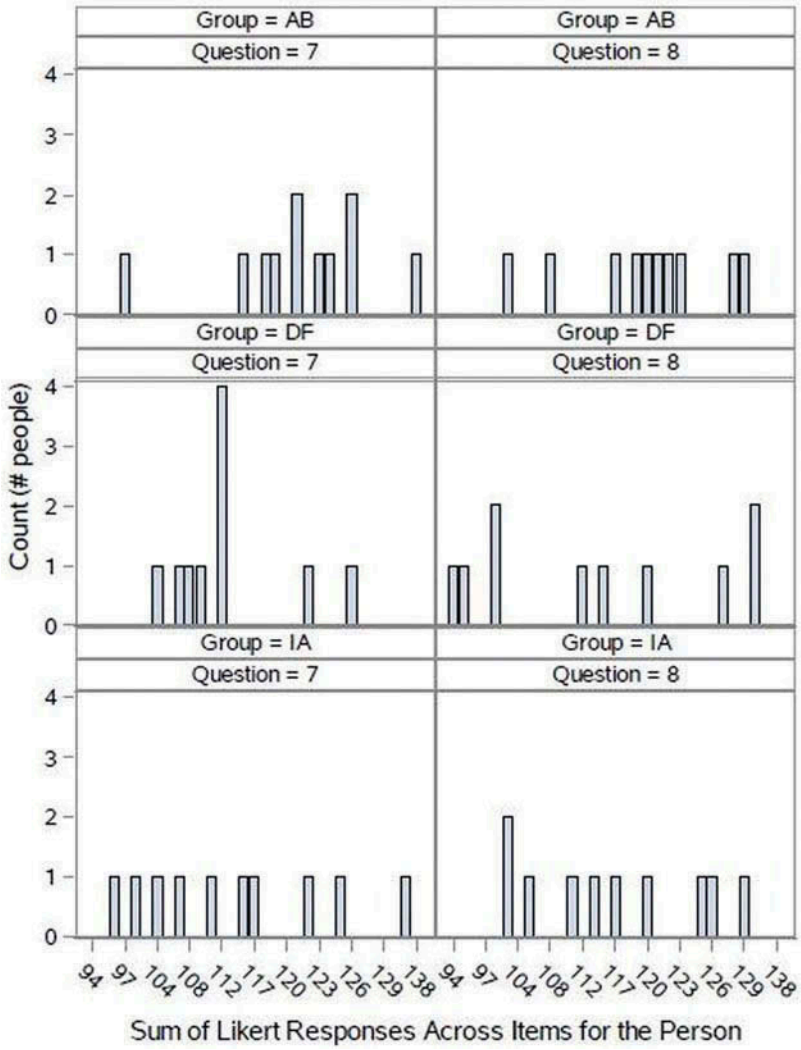

Figure 4. Number of respondents in each participant group by the sum of Likert responses across all items or cards for designing a program (Question 7) and implementing a program (Question 8).

Table 1. Design of a safety program, modes of cards by three groups of participants ranking themselves and each other.

Who should help design a farm safety program?		
	Pile-sort cards	
	Agricultural bankers	Insurance agents
Participants		
Dairy farmers	3	3
Agricultural bankers	4	4
Agricultural insurers	4	5

> No, you don't get part of the write-up that has anything to do with how I perceive safety. It would certainly be a risk if indeed I did see major issues out there – one thing or another – but, up to this point, there hasn't been… nothing that I've ever been involved with in regards to safety as far as a write-up or discussions on a loan…Well, if you made it law, that's another law that you have to deal with.

Bankers saw their job as only secondarily or tertiarily related to safety.

> I guess you can kinda see [safety hazards], but I don't address it. I address a management issue like are you trying to bite off more than you can chew. It would be better if you got someone else in here to help do things, but I do it more as trying to improve and help the management …not so much safety. I would say in general good management is gunna correlate with better safety.

The insurance agent item/card

Attitudes toward involving insurance agents in designing a farm safety program differed significantly in a Kruskal–Wallis test ($p < 0.05$). Farmers constituted most of the difference as their pairwise

Table 2. Implementation of a safety program, modes of cards by three groups of participants ranking themselves and each other.

Who should help implement a farm safety program?		
	Pile-sort cards	
	Agricultural bankers	Insurance agents
Participants		
Dairy farmers	3	4
Agricultural bankers	4	4
Agricultural insurers	5	5

comparison in Jonckheere–Terpstra tests revealed farmers to differ significantly from bankers ($p < 0.05$) and insurance agents ($p < 0.05$), but bankers and insurance agents were in general agreement with each other ($p = 0.35$). Similar results were obtained regarding the implementation of a farm safety program, although the comparison of bankers and insurance agents yielded a p-value of 0.98.

Insurance agents were more confident in their ability to implement a safety program (mode = 5, farmer would make the change as quickly as possible) than bankers had in their own ability (mode = 4, farmer would make the change eventually, see Table 2).

Similar trends can be observed in the qualitative data. While bankers were reluctant to see a role for themselves in designing and implementing a safety program, bankers lauded the potential of insurance agents to do the same.

> Maybe [the farmer] gets a discount from their insurance agent if they're doing [farm safety programs] – maybe that's the way you can leverage your safety program as to the insurance company might consider you a safer insurance risk if you are doing X, Y and Z.

Insurance agents echoed bankers' confidence regarding the role insurance agents can play in designing a safety program. In response to why he had put insurance agents as "necessary" to this work, one agent replied,

> You've got the – your professional associations, your ag and health safety experts, your medical people, insurance company, they either see the injuries or the claims from the injuries to have input about "Hey, we're seeing this type of injury in this situation, but not in this situation," so you can put the pieces together to figure out how to make it safer.

Insurance agents were believed to be less encumbered by regulation, more motivated to achieve safer farms, and more confident in their own ability to do so.

Discussion

This mixed-methods approach utilizing pile-sorting and semi-structured interviews revealed great detail in the kinds of relationships that can span across the interpersonal and community levels of the SEM model. It also revealed what the content and power of potential cues to action might be. Agricultural bankers and insurers can influence an individual farmer's decision-making about health and safety. However, the potential role of each in either designing or implementing a farm safety program is not viewed uniformly across the three groups of participants—dairy farmers, insurance agents, or bankers. The three groups disagreed more regarding who should help design a program than who should help implement such a program. Across all 32 cards, dairy farmers expressed more variability in their responses and generally had more negative opinions regarding who should be included, particularly when compared to bankers. Bankers were much more likely to include numerous individuals and institutions in the design of a farm safety program. Insurance agents were generally more confident in their ability to participate in the implementation of farm safety interventions than bankers had in their own ability to do the same. Bankers and farmers generally reiterated the possible roles of insurance agents.

Dairy farmers were more supportive of involving an insurance agent in designing and implementing a farm safety program, rating insurance agents higher than bankers for those tasks. These qualitative and quantitative data support involving insurance agents in particular in agricultural health and safety. This approach revealed that the content and power of the cues to action from the insurance agent may prove more impactful than the agricultural bankers' cues to action. Such cues to action can include an insurance agent identifying the most common and deadliest farm hazards while visiting the farm and discussing hazard remediation to reduce insurance premiums.

Dairy farmers, agricultural bankers, and insurance agents expressed a high rate of acceptance for the project. Several participants requested follow-up materials and project summaries. Not only is support for farm safety quantitatively and qualitatively evident, but it emerged as early as the recruitment phase for the study. This may be a possible bias amongst farmers, but is likely representative of bankers' and insurance agents' attitudes, though the true representativeness of this group is discussed in the limitations. As the data supports, insurance agents were excited to be recruited to do the study and interested in materials to help inform their discussions with farmers, which is another kind of cue to action detailed in HBM.

While SEM and HBM did not directly inform the questions posed in interviews and pile sorts, the constructs of these models were represented in the barriers identified by agricultural bankers (encumbered by regulations), the insurance agent-identified cues to action (using agricultural health and safety information to inform their conversations with farmers), and, the self-efficacy insurance agents demonstrated in ranking their capability to intervene highly during the pile sorts. In fact, self-efficacy is one of the most predictive concepts within HBM.[11–12] Additionally, the data allowed the connection between cards and their relationship to the farm, essentially constructing the SEM from "the ground, up", and identifying through statistical analyses (Kruskal-Wallis and exact Jonckheere-Terpstra tests) where a card's placement by one group generally differed from its placement by another group.

The other cards

The primary foci for this project were the relationships between central Wisconsin dairy farmers and agricultural bankers and agricultural insurance agents. These are the only three groups that the data can reveal mutual consensus about one another. However, the other cards in the pile-sorting questions emerged as important possible agents of change or influence, often with agreement across all three groups. These results are currently under further analysis and testing. The preliminary results may lead to important next steps. First, as expected, fellow farmers, spouses, and immediate family were highly ranked in terms of their knowledge and even more so for the level of trust that might enable the implementation of a safety program. Previous researchers have explored these individuals, but not necessarily in any large intervention endeavor.[21–25] Second, all three groups held veterinarians and agronomists in high regard for their ability to convince farmers to make changes in their operation. Third, agricultural health and safety experts were held in high regard toward the design of a safety program, but often fell in standing when it came to implementation. Last, results for extension agents were somewhat scattered. Interview data revealed that this assessment is highly dependent on the particular extension agent in the county where the participant resides, there being no choice as with insurance agents and bankers.

Unanticipated findings

The snowball recruiting process often led to questions of how many and of what quality agricultural insurance agents the research team was seeking. This led to three important and unanticipated findings. First, research participants felt that 10–11 agricultural bankers and agricultural insurers represented at least half of those in the professions in the region. If true, this bodes well for intervention design, as small clusters of the dominant agricultural insurers and bankers could be recruited and organized much more easily than farmers. Banks and insurance companies with regional focus and coverage may be particularly viable, though they may lack the financial leverage of larger companies. Given the confidence each group had in agricultural insurers' abilities to design and implement safety programs, including themselves, they seem to be a promising first target.

Second, the research team learned that most participants from all three groups believed there to be a shortage of high-quality agricultural insurance agents and bankers when compared to decades past. "High quality" was often characterized as "understanding farming," i.e., appreciative of the vagaries of income and amount of risk involved. This was often further contextualized with explanations that most older agricultural bankers and insurers were once farmers themselves and had sought the profession after retiring

from farming, giving them native knowledge and status in the profession. It was believed that with the shrinking amount of farmers and the prolific migration of young people away from farming, this line of farm-reared and seasoned professionals is dwindling. This was part and parcel to the third unanticipated result: research participants in all three professions believe there is a shortage of young, eager people interested to replace them in the future.

The second and third unanticipated results have both positive and negative implications for safety interventions looking to leverage agricultural bankers' and insurance agents' relationships with farmers. As the number of perceived high-quality agricultural bankers and insurance agents continues to stagnate or dwindle, their status in the eyes of farmers may do the same. The farmers' beliefs that these professionals can understand both farming and their profession may erode and any possibility of increasing safety's role in their relationship may do so as well. As young and beginning agricultural insurance agents and bankers do enter the field, they will likely not have a farm background and will need mentorship in all things agriculture, which presents an additional avenue of intervention. Agricultural health and safety experts should be keen on developing materials for and collaborating with those mentors, making health and safety integral to how future agents and bankers calculate and finance risk.

Generally, imagining the agricultural community around farmers through the lens of the SEM (spheres of influence) appears to be a fruitful direction. Moreover, applying what can be learned about these personal relationships can flush out more cues to action as suggested in the HBM. Applying agricultural health and safety knowledge through preexisting, imbedded relationships and cues to action therein, however, will require further research. Given the variability across agricultural communities, local knowledge will prove essential in determining which agents of change and cues to action are worth attempting.

Limitations

As a pilot project, the research team was very satisfied with the quality and quantity of data. The primary limitations given the size and scope of this project were the limited sample sizes and the amount of time necessary to accumulate the data. While 10 dairy farmers is not be representative of all central Wisconsin dairy farmers, it is interesting to note however, that participating agricultural bankers and insurance agents commonly believed that 10–11 in each profession represented at least half of central Wisconsin's population. Future studies should investigate the veracity of this claim. If true, these professionals represent a much more manageable intervention population than farmers themselves. These limitations are typical of a primarily qualitative approach based on one-on-one interactions across a large geographic region. Reaching more farmers with this approach would take a large amount of resources or advancement in the technology to capture similar kinds of data. Digital pile-sorting programs are emerging and could enable this wider catch. In terms of agricultural bankers and agricultural insurance agents, while small samples are likely representative of entire regions, statistical analysis can be difficult. Again, digital modes of pile sorting might resolve this. However, differences in states' and regions' agricultural production and insurance or banking systems may be a deterrent to consolidating these professions across wider regions.

Conclusion

Pile sorting combined with semistructured interview methods proved useful for researchers and enjoyable for research participants, albeit time consuming. Data revealed a good deal of consensus about the roles and relationships other members of the agricultural community can play in influencing farmers' decision-making about health and safety in their operations. Specifically, agricultural bankers and insurance agents have direct investments in the farmers' well-being and success. These financial ties could be leveraged toward safer behavior. Insurance agents were more confident in their ability to design and implement farm safety programs. Both bankers and farmers reinforced this finding. Bankers were thought to be less critical to design or implementation and feared federal and state laws concerning loan-giving would hinder their ability to create incentives.

Farmers have many possible points of leverage given the number of people connected to their success in daily life. Simply put, they are small businesses to which many people have connections. This creates opportunities for influence. Moreover, farmers, rural communities, and small towns may condense traditionally institutional level relationships down to the interpersonal, i.e., it is more likely that they know the head loan officer or lead loss control agent personally. This may mean that entire professions could be mobilized to promote agricultural health and safety. Continued research is necessary to identify those networks of professionals and provide them with agricultural health and safety knowledge they can meaningfully disseminate.

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Utilizing Secondary Agricultural Education Programs to Deliver Evidence-Based Grain Safety Training for Young and Beginning Workers

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ABSTRACT

Purdue University's Agricultural Safety and Health Program (PUASHP) has collaborated with secondary agricultural education programs, including FFA Chapters, for over 70 years to deliver and promote agricultural safety and health programming. With support from a U.S. Department of Labor Susan Harwood Program grant, PUASHP utilized a Developing a Curriculum (DACUM) process to develop, implement, and evaluate an evidence-based curriculum for use with young and beginning workers, ages 16–20, exposed to hazards associated with grain storage and handling. The primary audience was students enrolled in secondary agricultural education programs. A review of the literature identified a gap in educational resources that specifically addresses this target population. The curriculum developed was based on fatality and injury incident data mined from Purdue's Agricultural Confined Space Incident Database and input from a panel of experts. The process identified 27 learning outcomes and finalized a pool of test questions, supported by empirical evidence and confirmed by a panel of experts. An alignment process was then completed with the current national standards for secondary agricultural education programs. Seventy-two youth, ages 16–20, enrolled in secondary-school agricultural education programs, and a smaller group of post-secondary students under the age of 21 interested in working in the grain industry pilot tested the curriculum. Based on student and instructor feedback, the curriculum was refined and submitted to OSHA for approval as part of OSHA's online training resources. The curriculum was delivered to 3,665 students, ages 16–20. A total of 346 pre- and post-tests were analyzed, and the results used to confirm content validity and assess knowledge gain. Findings led to additional modifications to curriculum content, affirmed knowledge gain, and confirmed appropriateness for use with secondary agricultural education programs. The curriculum has been promoted nationally and made available for free download from www.agconfinedspaces.org. Findings further confirmed the value of delivering safety programming through established programs such as secondary agricultural education programs and FFA Chapters serving youth.

KEYWORDS

Agricultural education; agricultural safety; curriculum development; FFA safety programs; grain safety; young and beginning workers

Introduction

Since 1917, when the U.S. Congress passed the Smith-Hughes Act, secondary-school agricultural education programs have provided millions of America's youth with opportunities for leadership development, personal growth, and career success related to agricultural pursuits. Instruction has been provided through the three fundamental components found in every high school agricultural education program: (1) classroom/laboratory instruction (contextual learning), (2) supervised agricultural experience programs (work-based learning), and (3) student leader organization involvement in FFA.

Currently, over 800,000 students participate in formal agricultural education programs offered by over 11,000 instructors in grades 7 through 12 and adult education programs in all 50 states and three U.S. territories.[1] Instruction covers areas such as agriscience, agricultural mechanics, horticulture, animal science, and environmental science.

These secondary-school agricultural education programs serve as a host for FFA Chapters, with the instructor typically serving as the chapter advisor. In 2016, there were 649,355 FFA members nationally, ages 12–21, in 7,859 chapters located in all 50 states, Puerto Rico, and the U.S. Virgin Islands.[1]

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Agricultural safety and health instruction has always been an integral part of the mission of both agricultural education and FFA activities since their very beginning due to the hazardous nature of agricultural production and related occupations. Over the past 90 years, these programs have played vital roles in promoting activities aimed at reducing the frequency and severity of agriculture-related injuries and property losses, such as hazard awareness, adoption of safe work practices, and healthier life-style choices.

As part of the quality standards developed for agricultural education programs, including the recently developed Agricultural, Food and Natural Resources (AFNR) standards,[2] instructors have been encouraged to incorporate safety education and training on such topics as safe operation of agricultural equipment, safe use of shop tools, appropriate use of personal protective equipment, safe use of chemicals and safety around livestock. These programs have also encouraged carrying out community safety events and participation in local state and national safety competitions.

Through the agricultural education "Supervised Agricultural Experience" (SAE) program, students are provided opportunity to explore careers in agriculture, learn expected work place behaviors (e.g., safe work practices), develop specific skills within an agricultural occupation, (e.g., safe operation of machinery), and apply academic and occupational skills in a real or simulated workplace.[3]

As part of the FFA experience, each student is exposed to additional safety and health learning opportunities. Under provisions of the National FFA Chapter Planning and Recognition: A Student Handbook (2012–2016),[1] chapters are provided guidance on developing a "plan of activities" for promoting safety and health and receiving recognition as a "superior chapter."

Specific quality standards are provided for FFA activities in these areas: Growing Leaders, Building Communities, and Strengthening Agriculture. Safety and health issues are specifically addressed under two of the these areas: Growing Leaders has a component titled *Healthy Lifestyle* — activities that promote the well-being of students mentally or physically in achieving the positive evolution of the whole person; this could include: (i) substance abuse prevention and education and (ii) personal wellness choices and consequences. Strengthening Agriculture includes a component titled *Safety* — activities that enhance safety in the community; this includes: firearm safety programs, ATV safety, equipment operation safety, mock crashes, general farm safety, texting and driving campaigns, and safe animal handling demonstrations.

The Indiana FFA Organization, for example, has established the FFA Living to Serve Safety initiative as a means of encouraging chapters to become involved in making their communities safer places to live and work. Each year, the top ten chapters are recognized at the State FFA Convention. Chapters are also encouraged to ensure that "there is adequate instruction on the safety procedures that pertain to each unit of study" in the agricultural education classroom.

There is no evidence of another formally organized program in the United States that has a greater potential to reach young and beginning workers in agriculture with relevant safety and health information than the current national network of secondary-school agricultural education programs and their sponsored FFA Chapters.

Purdue University's involvement in dissemination of safety programming through secondary-school agricultural education programs

For over 70 years, Purdue's Agricultural Safety and Health Program has been involved, directly or indirectly, in developing and disseminating safety programming through secondary-school agricultural education programs and their sponsored FFA chapters. These efforts have included:

- Promotion of the use of hearing protection for youth operating equipment
- Creation of a statewide fire prevention program involving FFA members conducting fire prevention inspections of their homes and farmsteads
- Implementation of a statewide program to install over 17,000 updated safety decals on older on-farm grain bins
- Development and dissemination of a grain handling safety curriculum to every

agricultural education instructor in Indiana, Michigan, and Kentucky
- Development and dissemination of the "Gearing Up for Safety — Production Agriculture Safety Training for Youth curriculum to approximately 11,000 agricultural education programs in the United States, with funding from the USDA (This evidence-based curriculum fulfills the training requirement for 14–15 year olds seeking employment in agriculture as specified by the Agricultural Hazardous Occupations Order [Fair Labor Standards Act]. It is available as an instructor/leader CD, student CD for independent study, and online at www.agsafety4youth.info. An additional 3,000 copies of the instructor/leaders CD have been distributed to new agricultural education teachers at the National FFA convention.)
- Development of a curriculum introducing agricultural education students to the appropriate and safe use of assistive technologies for persons with disabilities in agricultural workplaces and disseminating it to approximately 11,000 agricultural education instructors and programs in the United States, with support from the USDA
- Distribution of over 3,000 copies of a power take off safety video to agricultural education programs in the Midwest
- Annual safety-related exhibits at the Indiana and National FFA conventions and at the Indiana State Fair FFA Building for more than 25 years[4]

In addition, for nearly 30 years, all agricultural education majors at Purdue University have completed a required course on agricultural safety as part of their teacher preparation plan of study. Additionally, in-service courses for teachers on various safety topics also have been offered. Over 50% of current agricultural education teachers in Indiana have completed a formal safety course and/or received safety resource materials for classroom use presented or developed by Purdue. It should be noted that several other land grant institutions have collaborated with agricultural education programs to sponsor similar initiatives.

Despite all of these safety programming efforts, serious youth-related safety issues in agriculture remain, including — and perhaps especially — in the area of grain storage and handling. To illustrate, in 2010, the Purdue Agricultural Confined Space Incidents Database (PACSID) documented a record number of grain related entrapments and engulfments, with a disproportionate number of the "victims" being under the age of 21. Likewise, more recent analysis of the PACID data have found that persons under 21 accounted for approximately 20% of grain entrapment/engulfment incidents with the fatality rate being about 80%.[5,6] Such "evidence" underscored the need to develop safety training resources and delivery strategies for young and beginning workers involved in grain storage and handling.

This article summarizes the development and implementation process, and testing results, for an evidence-based curriculum titled *Against the Grain*, designed specifically for young workers of ages 16–20 enrolled in secondary-school agricultural education programs. Also presented are the findings from the analysis of pre- and post-tests administered to participants during field-testing of the curriculum, primarily in classroom settings. This work reaffirmed the importance of collaborating with secondary-school agricultural education programs in the delivery of agricultural safety and health programming.

Curriculum development

Goals, desired outcomes, and assumptions

The initial goal of the *Against the Grain* curriculum, when proposed, was to provide evidence-based, basic-awareness-level safety and health training needed by youth who are interested in employment or recently employed in the commercial grain industry or who work on family-operated farms that have grain storage and handling operations. This curriculum was designed for use, primarily, in secondary-school agricultural education programs with flexibility for use by employers at grain operations required to be incompliance with OSHA regulations.

The desired outcomes were a reduction in the number of injuries and fatalities involving youth

engaged in grain storage and handling activities and to increase the awareness of supervising adults of the hazards associated with all types of confined spaces found in agricultural workplaces that pose a risk to younger workers.

The curriculum developers assumed that employers of young and beginning workers in the commercial grain industry recognize their responsibilities to meet OSHA workplace standards, including the training requirements and the personal protection provisions of the CFR1910.272 Grain Handling Standard. This standard requires that employers provide essential training to new employees and equip them with the appropriate personal protective equipment needed to help ensure that they remain safe and healthy at work. Currently, however, the OSHA regulations do not apply to youth employed at agricultural production sites, feedlots, and seed-processing facilities. These unregulated sites account for approximately half of the total U.S. grain storage capacity. The fundamental position taken in the development of the contents of the curriculum was that all youth exposed to grain handling hazards should receive the benefits derived from compliance with the relevant OSHA standards. First, because these standards represent current "best practices," and second, addressing the applicable standards was required as part of the Susan Harwood Grant requirements for curriculum development.

Target audiences

Youth who would benefit most from the proposed training include the following:

- High school agricultural education students and FFA members
- Youth working on family-operated grain farms (the population at highest risk) who likely do not receive the training required at OSHA non-exempt commercial grain operations
- High school students interested in a career or summer employment in agriculture or the grain industry who would benefit if certified as having completed a class on agricultural confined spaces and grain handling safety
- College students preparing for a career in the commercial grain industry
- Beginning workers in the commercial grain industry who did not participate in an agricultural education program or were not otherwise oriented to the hazards associated with the storage and handling of grain

Content development procedure

Since 1978, Purdue University's Agricultural Safety and Health Program has been documenting grain-related entrapment and engulfment incidents and, more recently, asphyxiations, entanglements, falls, and electrocutions in and around all forms of agricultural confined spaces. Over 1,850 cases have been so documented and entered into the Purdue Agricultural Confined Spaces Incident Database (PACSID).[7] Cases involving those under age 21 were analyzed, and the data were summarized.[6] The findings provided the foundation for developing the *Against the Grain* curriculum.

With support from a 2011–2015 Susan Harwood Grant through the U.S. Department of Labor, a formal curriculum development process (DACUM) was initiated.[8] The relevant literature was reviewed, including both injury prevention research related to childhood and young adult workplace injuries, and regulations aimed at providing protection for those under age 18. Utilizing the data found in the PACSID and the review of literature, a list of over 70 potential contributing factors was developed and refined by the project team. The advantage of this approach was that the factors were identified based on information from actual cases involving deaths and injuries to youth and, thus, have high content validity.

The team next determined that the list needed to be prioritized before being used for curriculum development purposes due primarily to the limited amount of time that could be devoted to this type of training, especially in secondary-school agricultural education settings that are required to meet state standards and, in some cases, to comply with National Agriculture, Forestry, and National Resources (AFNR) standards for curriculum content. The prioritized contributing factors would

then provide the basis for identifying the learning outcomes or desired core competencies that would be addressed in the curriculum.

In 2012, a panel of experts was assembled for two days to prioritize the contributing factors, to draft the initial set of desired learning objectives, identify any factors potentially overlooked, and to review samples of potential test questions. This process was led by Dr. Brian French, an educational measurement specialist at the Washington State University. Based on the list of prioritized learning outcomes, a series of five PowerPoint presentations, with supporting instructional resources, was developed that addressed each learning outcome at least once and, in some cases, more frequently due to priority level. Each lesson was designed to be carried out in a 45-minute session or collectively in a three-hour workshop setting.

During the spring and fall of 2013, the draft instructional content was pilot-tested with 4-H youth, secondary-school agricultural education students (grades 9–12), and post-secondary students studying agriculture at Purdue University. A total of 72 youth participated. (The content was also reviewed by agricultural education specialists for its applicability to youth ages 16–21 and for appropriate reading level.) The pilot training consisted of a series of three, 5-hour, out-of-school workshops to test the materials and make revisions as needed. These trainings included three hours of classroom instruction, a one-hour tour of a commercial grain storage facility, and appropriate breaks. Both pre- and post-tests were administered to the 72 participants.

Conducting the voluntary 5-hour sessions during "school time" proved to be problematic due to the inability of secondary teachers being able to commit 5 hours to the training due to the demands to cover other required instructional content. Curriculum content was again reviewed based on feedback and restructured to allow the five "stand alone" lessons, to be taught as five individual lessons or as one out-of-school program during a 3-hour time block with a recommendation to conduct a grain facility tour as a supplemental activity.

Content was also revised based on initial post-test results that showed insignificant knowledge gains. It was concluded that lack of knowledge gain was a reflection of higher-than-expected knowledge level of the subject matter and inadequate test question design rather than curriculum content. Utilizing a second panel of experts, a test-question pool containing 111 questions was developed and examined for content consistency and coverage of the critical areas. This pool was used to draw questions for use with all subsequent pre- and post-testing of training participants and for analysis of knowledge gain.

The material was subsequently submitted to OSHA for review and approved for use as part of the Susan Harwood Program online training offerings. During the spring of 2014, over 600 secondary-school agricultural education students participated in an additional round of testing of some or all of the curriculum components, including completion of either a pre- or post-test. The purpose of this testing was to document the participants' knowledge gain under controlled conditions, including use of the same instructional resources/contents and instructional team. Institutional Review Board approval was applied for and received to conduct this activity.

The curriculum was made available in December of 2014 at the project's website, www.agconfinedspaces.org. Feedback was encouraged from all agricultural educators who participated in the pilot tests of the curriculum and the pre- and post-testing events in secondary schools.

During 2015, an additional 419 young and beginning workers participated in the training. Three train-the-trainer classes on using the curriculum were held for agricultural education instructors. The curriculum was also introduced to approximately 160 Indiana agricultural educators at an in-service workshop, including instruction on accessing the contents from the project website. Lastly, the curriculum was presented to about 40 agricultural education majors at Purdue University prior to their student teaching experience, with each receiving a set of curriculum materials and being encouraged to use them during their student teaching.

The feedback gathered from both students and instructors using an assessment tool provided information that was used to revise the curriculum in the fall of 2015. Those revisions included

additional learning outcomes recommended by reviewers, further enhancement of the pool of test questions validated earlier by a panel of experts, and changing some of the visuals to enhance clarity and address new learning outcomes. The final list of 27 prioritized learning outcomes is included as the Appendix. The revised curriculum was then presented to an additional 321 students enrolled in post-secondary-school agriculture classes and 47 post-secondary-school students seeking employment in the grain industry following graduation. Plus, the curriculum was presented as three 1-hour webinars (sponsored by the *Grain Journal*) that reached over 300 young and beginning workers and safety professionals employed in the grain industry at worksites across the United States.

After the OSHA Susan Harwood Grant Project was completed in December 2015, additional minor revisions were made, based on additional feedback from secondary agricultural education teachers and additional reviewers gathered during the spring of 2016. The current curriculum was also presented to an additional 149 secondary-school students in 2016, with pre- and post-tests administered.

To date, approximately 3,665 youth, ages 16–20, have completed the training by the instructional team. The number of youth exposed to the training by instructors with access to the curriculum online or who were provided "hard copies" is unknown.

Findings

Administering pre- and post-tests

As part of the curriculum development process, four or five test questions were developed and tested for fit to each of the prioritized 27 desired learning outcomes. This 111-question pool is included as part the curriculum and accessible to instructors at the website. The questions can be drawn randomly and administered with reliable results. The pool was used to design pre- and post-tests to assess the curriculum with respect to participants' knowledge gained.

All youth participants in the initial curriculum development process were requested to take a pre-test and then a follow-up post-test upon completion of the training. The initial testing included only five test questions developed by the project team. The five-question strategy was modeled after pre- and post-testing methods used in online instructions. Follow-up testing relied on ten questions drawn from the pool of 111 validated test questions. All testing was voluntary to comply with the Human Subjects Research Committee's approved protocol. The curriculum was administered in three different formats: (1) face-to-face/classroom settings based in secondary-school agricultural education programs; (2) face-to-face classroom-based instruction involving post-secondary-school students enrolled in agricultural safety classes at Purdue University or students seeking future employment in the grain industry; and (3) online webinar-based instruction that included access to professional assistance via email or toll-free telephone number. Pre- and post-testing was conducted in only formats 1 and 2.

Data analysis

Data were analyzed for both the pilot and revised pre- and post-tests using SAS® 9.4. Distribution of scores was not normally distributed. Thus, the non-parametric Wilcoxon Rank Test was used to compare the difference between pre-test and post-test scores.[9]

Results

A total of 138 pre-tests and 231 post-tests were collected from secondary-school agricultural education students during the initial pilot testing of the curriculum using only five questions. As shown in Table 1, the average score of the pilot pre-tests was 95.07, while the average post-test score was 94.93; thus, there was no significant difference between the scores ($p > 0.05$). In other words, the students had greater knowledge of the

Table 1. Pilot test pre- and post-test scores from secondary agricultural education students.

	N	Mean	*SD*
Pre-test	138	95.07	10.2
Post-test	138	94.93	12.34
Pr ≥ |s|	0.9369		

hazards than was originally anticipated. In fact, there appears to be a ceiling effect where on average all students came to the pre-test with excellent levels of knowledge based on the questions used. This high level of pre-knowledge of the subject matter was not anticipated. These findings led to the revisions discussed above including validation of test questions by a second panel of experts, increase in the number of test questions to 10, and revisions to the curriculum contents.

A second round of testing resulted in 275 pre-tests and only 80 post-tests. The average scores of the pre-tests and post-tests were 57.38 and 75.38, respectively. There was a significant difference between the scores ($p < .0001$) as shown in Table 2, with a 31.4% average increase in the scores. Using the revised curriculum, 3-hour training workshops were conducted at Purdue University for upper-level students considering employment in the commercial grain industry and who had completed at least 3 years of college course work in agriculture.

A total of 73 pre- and post-tests were collected from these workshops. Since completion was voluntary, not everyone chose to participate in the testing. The average pre-test score was 96.88, while every one of the 73 test takers received 100% on of the post-test, with no difference between scores ($p > .05$). See Table 3. The p-value was greater than 0.05, which indicated the difference shown by the tests was not statistically significant (Table 3). The standard deviation of the post-test was 0, meaning each post-test got a full score. This also indicated that the test questions were too simple for older post-secondary-school agricultural students.

Table 2. Pre- and post-test scores from secondary agricultural education students using revised question and curriculum.

	N	Mean	*SD*
Pre-test	80	57.38	15.97
Post-test	80	75.38	21.22
Pr ≥ |s|	<.0001		

Table 3. Pilot test scores from post-secondary agricultural students.

	N	Mean	*SD*
Pre-test	32	96.88	7.38
Post-test	32	100	0
Pr ≥ |s|	0.0625		

Table 4. Revised curriculum pre- and post-test scores from post-secondary agricultural students enrolled in agricultural safety class.

	N	Mean	*SD*
Pre-test	96	74.35	21.75
Post-test	96	80.31	8.88
Pr ≥ |s|	<.0001		

Table 5. Combined the revised pre- and post-test scores from secondary agricultural education and post-secondary agricultural students.

	N	Mean	*SD*
Pre-test	176	59.15	16.59
Post-test	176	78.07	15.88
Pr ≥ |s|	<.0001		

Additional training, using the curriculum, was offered to those enrolled in Purdue's agricultural safety and health course comprised primarily of third- and fourth-year students. This training was conducted outside of class, and completion of pre- and post-tests was voluntary. A total of 120 pre-tests and 96 post-tests scores were collected and analyzed. Even though the knowledge gain was much less than that documented with the secondary-school students, the average pre- and post-test scores were 74.35 and 80.3,1 respectively, an 8% increase, which was statistically significant, as shown in Table 4.

When scores are combined for both the secondary-school agricultural education students and the post-secondary-school students enrolled in agriculture, who were administered the final version of the curriculum, there remained a significant difference between pre- and post-test scores, as noted in Table 5, with the result showing a 32% increase from the pre-test.

Conclusions

The project's finding indicates that the *Against the Grain* curriculum, as currently available, when presented to secondary-school agricultural education and post-secondary-school agriculture students, will result in significant increases in knowledge gain regarding the hazards related to grain storage and handling. Those enrolled in secondary-school education programs (the primary target population) showed greater knowledge gain compared to the older participants. There

was less knowledge gain shown for upper-level post-secondary-school agricultural students who completed the training.

Findings suggest that members of the target audience were more familiar with the hazards associated with grain storage and handling than was originally expected, due possibly to the large number of participants in the study being from farm backgrounds or from farms producing grain. This led to revisions in both content and test questions. Participants at opposite end of the age spectrum showed significant differences in their pre-knowledge of the subject matter.

The number of secondary-school agricultural education programs that were willing to incorporate the training into their curriculum was higher than originally expected. During the study, approximately 50 different schools were involved, providing 3,515 students with no less than 6,569 hours of documented instruction.

Another indicator of the curriculum's acceptance is reflected in the number of visitors to the project's website, where instructors may freely download the curriculum contents, test questions, and PowerPoint presentations. During the first year, the site was available. In 2013, it hosted 83 visitors; in 2014, that number grew to 891; there were 5,419 visits in 2015; and the number reached 2,043 in 2016. It is believed that this "healthy" site traffic was due to the distribution of flyers describing the curriculum at the National FFA Convention in 2015 and 2016.

Recommendations

Efforts are under way to further update the curriculum to reflect new findings, specifically those related to non-entrapment-related injuries to young and beginning workers in the grain industry or who may be exposed to other types of agricultural confined spaces such as silos and manure pits. Feedback from users of the curriculum over the past four years is also being incorporated. Further alignment with current agricultural education standards (AFNR) and individual state standards, which continue to be modified, needs to be made to increase the likelihood of the curriculum utilization where these standards have been adopted. More attention needs to be given to encouraging secondary school agricultural educators to recognize the tremendous influence they have over their students in adopting safer worker practices, especially those related to grain storage and handling.

Based on feedback from attendees at the National FFA Convention, there is also a demand for the materials to be made available on a Flash drive or CD due to the slow download speeds at many rural schools that host agricultural education programs. The use of complex, multi-image PowerPoint slides can greatly increase the download time.

It is believed that the findings demonstrate that secondary-school agricultural education programs should continue to be considered as a viable means for delivery of agricultural safety and health programming to youth. It may also be even more effective than the use of safety professionals to reach farmers indirectly through the youth participants with the same content. This collaboration could be further enhanced if the resources were introduced to students in agricultural education teacher training programs across the United States and during in-service training of current teachers.

Considering that the frequency of grain-related injuries and fatalities involving youth is relatively low, and the amount of the time secondary-school educators have to focus on safety and health topics is limited, care needs to be taken to prevent de-emphasizing higher risk behaviors or exposures such as tractor rollovers and falls from equipment. Priorities need to be established based on actual injury data and to ensure that young workers with the greatest risk of exposure are provided training.

Finally, it is believed that the curriculum provides an evidence-based approach to conduct preliminary safety training and testing of young and beginning workers exposed to the hazards of grain storage and handling. Completion of the training would provide important documentation for meeting current OSHA workplace safety regulations.

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Appendix. Prioritized learning outcomes for *Against the Grain* curriculum

(1) Explain the importance of the grain industry to a viable U.S. economy.
(2) Identify career opportunities for young and beginning workers within the grain industry.
(3) Know that young and beginning workers account for nearly 20% of injuries and fatalities at grain storage and handling facilities.
(4) List those characteristics of young and beginning workers that increase their risk of injury in the workplace.
(5) Describe the general movement of grain from field to final products.
(6) Describe the characteristics of an agricultural confined space, including those regulated under the OSHA standards.
(7) Identify the types of confined spaces that can be found in and around agricultural workplaces, including grain storage/handling operations.
(8) Recognize the primary hazards associated with grain storage, handling, and processing facilities, especially those related to confined spaces.
(9) Explain the difference between an OSHA exempt and an OSHA non-exempt grain storage and handling operation.
(10) Explain the rights of young and beginning workers to refuse to perform certain hazardous tasks for which no training or personal protective equipment has been provided or to file a complaint regarding unsafe work practices under the provisions of the Occupational Safety and Health Act.
(11) Identify the most common contributing factors and injuries involving agricultural confined spaces.
(12) Identify the most frequent types of entrapment, engulfment, and entanglements that can occur in grain storage, handling, and processing facilities.
(13) Understand the characteristics of free-flowing grain.
(14) Recognize the relationship between out-of-condition grain and grain by-products and potential increased risk of entrapment, engulfment, and entanglement.
(15) Identify the key requirements for proper and safe long-term storage of grain.
(16) Identify factors influencing the trend in grain-related entrapments.
(17) Describe the characteristics of a safe and productive worker.
(18) Describe the basic safe work practices that should be followed to reduce the frequency and severity of injuries at grain storage, handling, and processing operations.
(19) Identify the tasks or activities that require use of personal protective equipment based on best safe work practices.
(20) Identify the types of personal protective equipment and clothing used or worn in the grain industry to prevent personal injuries.
(21) Understand the restrictions related to the employment of youth under the age of 16 in agricultural workplaces (including confined spaces) contained in the Agricultural Hazardous Occupations Order.
(22) Understand the added risks that confront young and beginning workers employed on farms not covered by OSHA workplace safety rules.
(23) Explain the rights of all workers to be provided a safe and healthy workplace under the provisions of the Occupational Safety and Health Act.
(24) Describe the steps that young and beginning workers should take to communicate to their employer information about an unsafe work environment or work practices, or their need of training.
(25) Describe the characteristics of an incident that requires an emergency response.
(26) Identify the most frequent types of emergencies at grain storage/handling operations.
(27) List the steps that should be taken in an emergency at a grain storage, handling, or processing facility, including entrapments, entanglements, falls, asphyxiation, heat stress, electrocutions, fires, and explosions.

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Assessment of Tribal Bison Worker Hazards Using Trusted Research Facilitators

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ABSTRACT

Objectives: Agriculture is one of the most hazardous industries in the United States. Within agriculture, livestock handling is particularly dangerous. While injury and fatality rates for bison handlers have not been reported, workers in many of the newly established tribal bison herds have limited safety training and animal handling experience, making this a vulnerable workforce. Veterinarians and herd managers, working with tribal bison herds, recognized the need for improvement in the working environment and for worker safety training. In response, partnerships were established and a pilot project was developed in order to characterize risks and hazards associated with bison handling under contemporary reservation field conditions. Individuals and organizations working as change agents included veterinarians at the University of Nebraska – Lincoln School of Veterinary Medicine, a tribal advocacy organization, the Intertribal Buffalo Council and researchers at the Central States Center for Agricultural Safety and Health at the University of Nebraska Medical Center. Methods: This is a mixed-methods study and data were gathered through closed and open-ended questions pertaining to bison worker safety hazards. A veterinarian gathered data through observational safety audits at bison herding locations. American Indian bison herd managers completed surveys using a convenience sampling method. Results: Findings indicate that the most common worker safety risks are associated with the use of high-stress handling methods and substandard facilities and equipment. Adverse environmental conditions also contribute to worker health risks. Most common causes of injuries included those caused by equipment and tools, adverse weather, and direct contact with animals. Conclusion: This collaborative research study contributes to a better understanding of hazards faced by tribal bison workers. Findings from this research influenced the ITBC in their decision to add worker safety and health training to the agenda of their yearly conference and promote tailgate trainings for their workers. UNL veterinarians have taken the lessons learned from this research and provided safety and health information to mangers of other non-tribal bison herds. This research partnership will continue with a 5-year research study focusing on best management practices and establishing training to improve the health and safety bison workers.

KEYWORDS

Bison worker; hazards; Native American; research facilitators; risks

Introduction

Agriculture is one of the most hazardous industries in the United States with a reported fatality rate of 22.2 deaths per 100,000 workers in 2013 and approximately 150 hired agricultural workers suffering from a lost-work-time injury daily.[1–3] Within agriculture, livestock-handling is particularly dangerous. Indeed, several studies indicate that having livestock doubles the risk of injuries compared to those who have no livestock. Livestock-handling injuries are also among the most severe of all agricultural injuries.[4,5]

Bison, while similar in some ways to cattle, are not traditionally included in the term livestock. They have not been bred for docility like other livestock and are known to attack humans if provoked. Injury and fatality rates for bison handlers have not been documented. Bison are the largest native land mammal in North America, with males weighing up to 2,000 pounds.[6] Despite their large size, bison can run up to 35 miles per hour and pivot quickly.[6] Bison are the most dangerous animal in Yellowstone National Park.[7,8]

Bison, raised primarily in free-range environments, are generally only exposed to humans during bison roundups. A bison roundup entails herding bison into a holding facility for health

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Figure 1. Bison being corralled using all-terrain vehicles, horses, and helicopters.

inspection, vaccination, and culling (Figure 1). Herding is typically done using all-terrain vehicles (ATVs), utility vehicles (UTVs), horses, and other vehicles including helicopters. Once the bison are corralled, workers usually enter the pens to encourage the animals to move forward into a chute.

The demand for bison meat has increased in the United States, which has led to an increase in the number of employees in the field of bison production.[9] As bison production expands, more workers will be exposed to bison in close quarters. Workers in many of these newly established bison herds have not received formal training and may have limited animal handling experience, making this workforce vulnerable to injury and fatalities.

There are approximately 420,000 head of bison in the United States and Canada.[10] Bison reached near extinction in the late 19th century, but were reintroduced to tribal lands in the 1990s by the Intertribal Buffalo Council (ITBC).[11,12] ITBC has a membership of 58 tribes in 19 states with a collective herd of over 15,000 bison. ITBC represents most of the tribal bison herds in the United States. ITBC reestablishes bison herds on Indian lands in ways that promote cultural enhancement, spiritual revitalization, ecological restoration, and economic development.[12] ITBC acts as a facilitator in coordinating education and training programs, developing marketing strategies, coordinating the transfer of surplus buffalo from national parks to tribal lands, and providing technical assistance to its membership.[12] The organization is governed by a Board of Directors and is a federally chartered Indian Organization under Section 17 of the Indian Reorganization Act.[12]

After working for many years to improve the health of bison herds managed by Native American tribes, veterinarians and herd managers increasingly recognized the need for improvements in the working environment and for safety training for those working with bison. Minimal data exist on the occupational safety and health risks for those working with these animals. Research conducted in this field has been focused on low-stress bison handling, with the goal of animal safety rather than worker safety.[13,14]

In 2012 there were 58,475 American Indian farmers in the United States operating 5.6% of the farmland. Two-thirds of these farmers specializing in livestock production.[15] Although agriculture is historically and currently important to American Indians, there is a lack of research and resources focused on this population. There are known health disparities related to agricultural accidents and injuries among American Indians, a population that already experiences stark health disparities.[16,17] Untrained workers, handling large, powerful bison in facilities that may be inadequate, are all factors that contribute to increased risk of injury and illness.

A collaborative pilot research project was developed between the Central States Center for Agricultural Safety and Health (CS-CASH) at the University of Nebraska Medical Center (UNMC), the University of Nebraska – Lincoln (UNL) School

of Veterinary Medicine, and the ITBC. The aim of this project was to assess the hazards associated with bison handling in the American Indian population.

UNL veterinarians and members of ITBC served as change agents from the onset of the pilot project, providing the CS-CASH research team with a vision of the wide range of safety and health problems, knowledge of the issues, and with appropriate questions to ask to determine the wide range of hazards. These partners have long-term, trusted relationships with bison herd managers and workers, the subjects of this research. In creating the survey instrument, UNL veterinarians lent an understanding of animal handling practices and facilities and first-hand knowledge of past incidents involving bison workers. ITBC served as a trusted partner providing a cultural framework, a clear understanding of the issues, and the motivation and desire to improve worker safety practices. CS-CASH researchers and outreach professionals brought expertise in livestock worker safety practices and research techniques to this collaborative effort. Results from this pilot research will be used to develop best practice guidelines and safety and health interventions that will address the occupational safety and health needs of tribal bison handlers.

Methods

Human Subjects Research approval was obtained from the UNMC Institutional Review Board. This mixed-methods (quantitative and qualitative) project utilized primary data, which were collected using direct observational audits of tribal bison workers and convenience surveys of herd managers. The two surveys were designed to gather similar information on bison worker safety and health practices, hazards, and injuries from two different populations. Data were analyzed to identify hazards and provide information on the occupational safety and health needs of American Indian bison handlers. This research project did not directly gather data from tribal bison handlers due to the transient nature of this population. These workers are generally members of the tribe that own the bison herd. The bison are processed just a few times a year. While the herd managers generally have livestock handling expertise, tribal workers may have little to no livestock experience when they are hired to assist with the roundup. The worker population is not consistent from year to year.

Data collection

This project was a university, institution, and community partnership between UNL, ITBC, CS-CASH, and the tribal herd worker community. UNL's School of Veterinary Medicine has an established trusted working relationship with tribal herd managers, expertise in animal handling practices, and knowledge of the issues. UNL veterinarians, who have worked to improve the health of tribal herds for 6 years, recorded observational surveys during tribal roundups and provided a trusted and knowledgeable agent for this method of data collection. CS-CASH researchers and outreach professionals provided expertise in health promotion, conducting research with American Indian communities, livestock worker safety, and mixed-methods research expertise. Members of ITBC are an influential tribal advocacy organization, served as a trusted partner providing cultural framework and "front-line" understanding of the issues, and provided access to tribal herd managers and on-site bison roundups.

Observational safety survey

The observational safety survey instrument (Appendix A, see supplemental data) was created by experts in the fields of health promotion, veterinary medicine, and agricultural and occupational safety and health. This survey was observational and was completed on-site by a UNL veterinarian with expertise in bison handling and health. Survey questions addressed working conditions, environment and facilities, worker attire, bison handling techniques, animal behavior, injuries, and safe use of animal medication. This survey used close-ended questions inquiring about the occurrence of specific behaviors or outcomes with three answer options (Yes, No, and Not Applicable) and two open-ended questions ("If safety hazards were present, please list them here" and "If worker injuries were observed, please list how many and their causes"). The observational surveys were conducted over 17 days at 10 working locations during bison roundups at Sitting Bull College Bison Herd (Mobridge, South Dakota), Standing Rock Sioux Tribe West Pasture (Fort Yates, North Dakota),

Standing Rock Sioux Tribe North Pasture (Fort Yates, North Dakota), and Pine Ridge Reservation (South Dakota) during 2014 and 2015.

Herd manager: Perceptions of hazards survey

This survey (Appendix B, see supplemental data) was distributed to American Indian free-range bison herd managers attending the ITBC conference in Las Vegas, Nevada, in 2014. The aim of this survey was to assess the safety hazards observed by bison herd managers during roundups. Managers were asked to recall the environment and facilities, worker attire, bison handling techniques, animal behavior, injuries, and safe use of medications at their roundup sites. This survey utilized close-ended questions inquiring about the occurrence of specific behaviors or outcomes with three answer options (Yes, No, and Not Applicable) and two open-ended questions ("What do you consider to be the greatest safety hazards to bison workers?" and "If you have observed worker injuries, please list the type and cause of the injury"). Additionally, participants were encouraged to write in any other comments on the survey. The survey contained no personal identifiers.

Data analysis

Quantitative data were analyzed using IBM SPSS Statistics software. The qualitative data from open-ended questions were analyzed using a two-step process. A First Cycle Descriptive Coding Method was conducted to analyze each open-ended question.[18] This first cycle decoded the data by specifying keywords and phrases that were common across the responses. After codes were categorized in the first cycle, they were compared to each other. Next a Second Cycle Pattern Coding Method was used to further the divide the categories into subcategories, or consolidate if necessary.[18]

Results

Quantitative data

Observational safety survey

The observational audit survey was completed by a veterinarian at 10 different locations over a total of 17-days during bison roundups between 2014 and 2015. Bison roundups and processing took between 1–2 days to complete, depending on the number of bison in the herd. Table 1 demonstrates safety and health risks observed during the bison roundups.

Herd manager: Perceptions of hazards survey

This survey was distributed to tribal bison herd managers attending the 2014 ITBC Conference. There were 33 respondents to this survey with a response rate of 37.5%. Tribal bison herd manager's perceptions of hazards are shown in Table 2.

Qualitative analysis

The following are results of the qualitative data from the open-ended questions "If safety hazards were present, please list them here" and "What do you consider to be the greatest safety hazards to bison workers?" from the Observational Safety Audit Survey and the Herd Manager – Perceptions of Hazards Survey, respectively. The first cycle of descriptive coding of the raw data developed the following 14 labels: obsolete equipment, poor facility design, broken equipment, inadequate equipment, use of high-stress handling techniques, stressed animals, adverse weather, excessive dust, handler behaviors, dangerous use of ATVs and/or other vehicles, direct injuries to workers, alleyways, footwork on the ground, and bison escaping. These labels represent various safety risks to bison handlers. The second-level pattern coding phase of the qualitative data analysis summarized or consolidated the initially discovered codes. During this level of coding, the data from the first-level coding were recorded by grouping the 14 labels into 7 categories or themes. Table 3 lists the seven categories derived in the second-level coding and their respective first-level coding labels.

The following are the results from the qualitative data from the open-ended questions "If injuries occurred, please list them here" and "If you have observed worker injuries, please list the type and cause of the injury" from the Observational Safety Audit Survey and the Herd Manager – Perceptions of Hazards Survey, respectively. The first cycle descriptive coding of the raw data developed the following 16 labels: head injury from contact with equipment, cut in hand from knife, gate fell on worker's foot, frost bite, hypothermia, kicked by bison, pinched fingers, lacerations from

Table 1. Summary of responses from the observational safety survey (10 sites) N/A = not applicable.

	Percentage response		
Evaluation statement	Yes	No	N/A
Environment and facilities			
Dust was present during processing.	60.0	40.0	0.0
The corral system needs modification.	70.0	30.0	0.0
The corral system needs repair.	70.0	30.0	0.0
The animals exited the chute with no chance of worker contact.	50.0	50.0	0.0
Trip slip and fall hazards were present.	60.0	40.0	0.0
Light was diffused so that minimal shadows were present.	30.0	70.0	0.0
Moving or flapping objects were present.	40.0	60.0	0.0
The working chute was the appropriate width.	100.0	0.0	0.0
Worker attire and safety equipment			
Safety glasses were worn.	0.0	100.0	0.0
Gloves were worn.	70.0	30.0	0.0
Long pants were worn.	100.0	0.0	0.0
Work boots with appropriate soles were worn.	90.0	10.0	0.0
Respirators were worn.	10.0	90.0	0.0
No loose, baggy clothing or hanging jewelry was present.	100.0	0.0	0.0
Long hair was pulled back.	100.0	0.0	0.0
Telephone or communication device was available[a].	100.0	0.0	0.0
Fire extinguisher was present[a].	0.0	100.0	0.0
Bison handling			
Bison were gathered at a slow pace.	30.0	70.0	0.0
Personnel moved slowly without making excessive noise.	40.0	60.0	0.0
Excessive poking, beating on, or multiple electric prod use on animals occurred.	40.0	60.0	0.0
Workers always had an escape route.	100.0	0.0	0.0
Young bison kept close to mothers.	100.0	0.0	0.0
Appropriate number of workers present.	100.0	0.0	0.0
Workers maintained safe distance from animal's head.	100.0	0.0	0.0
Panting observed in animals.	70.0	30.0	0.0
Injuries			
Bison injuries occurred.	90.0	10.0	0.0
Worker injuries occurred.	30.0	70.0	0.0
Safe use of medications			
Syringes and needles disposed of properly[b].	100.0	0.0	0.0
Needle sticks did not occur.	100.0	0.0	0.0

[a]Questions were not included in the original survey, responses represent 7 observation sites.
[b]The observer skipped this question on one survey, responses represent 9 observation sites.

horn caps, arm hurt in chute, slipping and falling, ATV accident, injuries caused by horses, feet stepped on by bison, fingers squeezed in chutes, fingers slammed in gates, and twisted ankles. During the second level of pattern coding, the data from the first-level coding were recorded by grouping the 16 labels into 7 categories, or themes. Table 4 lists the seven categories derived in the second-level coding and their respective first-level coding labels.

Discussion

Findings from the mixed-methods survey research demonstrate a wide range of safety and health hazards present during tribal bison roundups and handling. This collaborative research used partners who are trusted in the tribal community to inform and facilitate the collection of data, and these partners will put the lessons learned into safety practice.

Environment and facilities

Results indicate that dust was present during handling at over 50% of the facilities. Additionally, very few workers used respiratory protection. Agricultural and specifically livestock dust exposures are known to contribute to the development of chronic obstructive pulmonary disease (COPD).[18–20] Age-adjusted rates for death caused by COPD indicated that American Indians died second most often from this disease, falling just behind the rates for non-Hispanic whites.[21] This project identified dust exposure as a health risk to bison workers.

Results show problems with the integrity of the corral structures including obsolete equipment,

Table 2. Summary of responses from herd managers – perceptions of hazards survey (N = 33) N/A = not applicable.

	Percentage response		
Evaluation statement	Yes	No	N/A
Environment and facilities			
Dust is present in the air during processing.	69.7	27.3	3.0
The corral system needs modifications.	81.8	18.2	0.0
The corral system needs repair.	63.6	33.3	3.0
Trip, slip, and fall hazards are present.	66.7	30.3	3.0
Animals can exit the chute with no chance of worker contact.	69.7	21.2	9.1
Light is diffused so that minimal shadows are present.	45.5	36.4	18.2
Moving or flapping objects are present.	24.2	69.7	6.1
Working chute is the appropriate width.	90.9	6.1	3.0
Worker Attire and Safety Equipment			
Gloves are worn.	78.8	18.2	3.0
Long pants are worn.	87.9	9.1	3.0
Work boots with appropriate soles are worn.	69.7	27.3	3.0
Dust masks are worn.	15.2	75.8	9.1
No loose, baggy clothing, or hanging jewelry is present.	39.4	51.5	9.1
Long hair is pulled back.	72.7	15.2	12.1
Telephone or communication devices are available.	93.9	0.0	6.1
Fire extinguishers are present.	39.4	48.5	12.1
Bison Handling			
Bison are gathered at a slow pace.	69.7	18.2	12.1
Personnel move slowly without making excessive noise.	72.7	21.2	6.1
Excessive, poking, beating on, or multiple electric prod use occurs.	4.2	63.6	12.1
Workers always have an escape route.	57.6	33.3	9.1
Young bison are kept close to their mothers.	54.5	24.2	21.2
The appropriate number of workers is present.	69.7	24.2	6.1
Workers maintain a safe distance from animal's head when in head catch.	81.8	3.0	15.2
Panting is commonly observed in corralled animals.	48.5	36.4	15.2
Injuries			
Bison injuries have occurred.	66.7	21.2	15.2
Worker injuries have occurred.	30.3	54.5	15.2
Safe Use of Medications			
Syringes and needles are disposed of properly every time.	54.5	12.1	33.3
Needle sticks have occurred.	6.1	48.5	45.5

Table 3. Safety risks to bison handlers, qualitative analysis secondary coding.

Inadequate facilities	High-stress bison handling	Adverse working conditions	Handler behavior	Direct injuries to workers	Alleyways	Footwork on the ground
Obsolete equipment	Use of high-stress handling techniques	Adverse weather	Handler behavior	Injuries caused by workers	Alleyways	Footwork on the ground
Poor facility design	Stressed animals	Excessive dust	Dangerous use of ATVs and/or other vehicles	Injuries caused by bison		
Broken equipment						
Inadequate equipment						

Note. Data analyzed are from the open-ended questions "If safety hazards were present, please list them here" (N = 17) and "What do you consider to be the greatest safety hazards to bison workers?" (N = 33) from the Daily Bison Handling Worker Survey and the Causes of Bison Worker Safety Hazards, respectively.

Table 4. Most common injuries incurred by bison handlers, qualitative analysis secondary coding.

Injury caused by equipment	Injury caused by tools	Injury caused by weather	Injury caused by animals	Injury caused by ATV	Injury caused by horses	Injury caused by footwork
Head injury from contact with equipment	Cut in hand from knife	Frost bite	Kicked	Injury caused by ATV	Injury caused by horses	Twisted ankles
Gate falling on worker	Pinched fingers	Hypothermia	Stepped on			
Arm injured in chute		Slipping and falling on ice	Lacerations from horn caps			
Fingers squeezed in chute						
Fingers slammed in gates						

poor facility design, and broken equipment. Observations by the veterinarian indicate that 50% of the facilities had inadequate barriers in place to ensure that bison cannot make contact with the workers after exiting the chute. Although specific details of the deficiencies were not indicated in this study, it can be inferred that the corral structures and lack of barriers can be identified as a safety hazards.

Slip, trip, and fall hazards were recognized in over half the survey data. This is not surprising, as roundups take place in the late fall and winter months, exposing workers to rain, snow, ice, humidity, and slippery and uneven surfaces. These findings were in keeping with previous studies. For example, research looking at workers' compensation claims data for non-fatal injuries among agriculture and agri-business workers in Colorado found that falls or slips were among the most frequent causes of injury.[22] This study clearly recognized slips, trips, and fall hazards as a risk to bison handlers.

Problems were also identified with the diffusion of light and with flapping objects, causing the animals to balk or startle as they move through the chute. These disruptions may require workers to move into closer proximity with animals in order to herd them through the handling facility, thereby increasing the possibility of contact with the animal and injury to the worker.

Worker attire and safety equipment

Although tribal bison workers wear gloves and long pants, 27% of the managers indicated that their workers did not wear appropriate footwear, possibly resulting in an increase in slips, trips, and falls. Deficiencies were noted with the use of personal protective equipment (PPE) including dust masks, as previously discussed, and safety goggles. The need for safety goggles while working bison may not be clear, but goggles are an important component of an ATV rider's safety equipment. Herd managers noted ATVs, commonly used to round up bison, as the cause of worker injury. Tribal bison handlers are not unique in their low rate of PPE use; in general, use of PPE by many agricultural workers is low.[23,24] Herd managers indicated that loose clothing and jewelry are worn by workers, resulting in possible entanglement, choking, or dismemberment and is, therefore, noted as a risk. The study also noted that fire extinguishers are not present at many sites. It is likely that uncontrolled fires at roundups may emanate from cigarettes, vehicle exhaust systems, or sparks from wood being burned for warmth, presenting a worker safety risk.

Bison handling

High-stress handling is a human-centered method of working with livestock that entails using techniques that cause stress in the animals including loud noises, hitting animals excessively, using stressful facilities (e.g., walls without solid sides), and other stressful techniques.[14,25] Research indicates that human injury risks are higher when cattle were moved by high-stress methods.[26] The observing veterinarian indicated that high-stress handling (gathering at a fast pace, excessive noise, and prodding animals) was occurring at a higher rate than was indicated by the herd managers. A veterinarian noted that "ATVs were used on the hillside to chase bison at high speeds." This discrepancy in findings may result from a difference in perception, gaps in knowledge regarding proper use of low-stress techniques, or reluctance by managers to indicate that these methods were being used. Both managers and the observing veterinarian recorded that panting was observed in corralled bison, an indicator that the animals have been moved at a fast pace and may be experiencing stress.[25] This observation is in-line with observations of high-stress handling by the veterinarian and validates that high-stress handling methods are being employed.

Bison and worker injury

Bison injuries were recorded by the observing veterinarian at 9 out of 10 sites, and 67% of managers indicated that bison injuries had occurred during roundups at their sites. This may be reflective of high-stress bison handling, as discussed previously, and could result in worker injury.[26]

The observing veterinarian recorded injuries to workers occurring at 3 of the 10 sites, and 30% of the managers indicated that worker injuries had occurred at their handling facilities. The most common injuries to workers were caused by equipment, tools, weather (frost bite, hypothermia, and slipping and falling on ice), contact with bison, ATV use, horses, and footwork. One manager noted that there had been "several

high speed ATV wrecks at the facility, in each case workers were going too fast and not paying attention." Another reported that "a worker was kicked in the chest by a bison calf." There is no other research available that could be used to compare the types of injuries. However, there is data on injuries incurred when working with large livestock, such as cattle.[5,27,28] Injuries from cattle are primarily caused by cattle themselves, such as cattle making contact with workers or cattle pushing structures into workers.[4,27] Also, there are interventions targeting safety during livestock handling, but none of these interventions focus directly on bison handling.[29–34] Our research indicates that many of the bison worker injuries are likely due to hazards inherent in the tribal bison roundup. These bison are free-range and must be herded long distances, using ATVs and horses, into holding corrals, and subsequently moved into chutes and head gates. Unlike most cattle herds, tribal bison herds usually have little to no contact with humans most of the year and docility has not been bred or selected for in these animals. Adverse weather conditions in the fall and winter seasons may lead to injury. Due to the unique nature of bison and tribal bison roundups, existing research related to cattle handling hazards is not entirely applicable.

Safe use of medications

The veterinarian did not witness any needle sticks over 17 days of observations but two herd managers indicated that needle sticks had occurred during handling at their facilities. Research found that performing medical tasks is a risk factor in cattle handling.[4] Because of the danger posed to human health by veterinary pharmaceuticals[35] and the possible transmission of zoonotic diseases, needle sticks should be indicated as a health hazard for bison handlers. There are 15 cattle diseases with zoonotic potential in the United States, including anthrax, brucellosis, cryptosporidiosis, dermatophilosis, *Escherichia coli*, giardiasis, leptospirosis, listeriosis, pseudocowpox, Q fever, rabies, ringworm, salmonellosis, tuberculosis, and vesicular stomatitis.[36]

Agents of change

The collaborative institutional partnership of UNL veterinarians, ITBC, and CS-CASH worked effectively to collect tribal herd worker data. These data validated anecdotal observations by UNL veterinarians and tribal herd managers regarding unsafe worker practices and workplace hazards. UNL veterinarians continue to travel to round-ups monitoring tribal herd health. Knowledge gained from this research will allow them to suggest work-site safety improvements to tribal herd managers and to protect themselves.

This research raised awareness of safety and health concerns in ITBC herd managers and administration. ITBC has begun to include safety training in the agenda of their annual conference. Materials to conduct tailgate trainings, 10-minute on-site safety sessions produced by CS-CASH, have been disseminated to all the ITBC member tribes. Herd managers have been encouraged by the ITBC to use these materials.

Tribal communities are oftentimes inaccessible to researchers, making these trusted institutional partners crucial for completion of this project. Importantly, UNL veterinarians and ITBC will continue to be the impetus for behavioral change in the herd workers after the researchers are no longer involved.

CS-CASH has contacted other influential gatekeepers including private veterinarians and managers of nontribal bison herd workers to enlist their assistance in promoting safe and health practices in bison workers.

Strengths and limitations

A strength of this study was the strong university–community partnership between the three different entities. Collaboration with trusted tribal partners, the UNL School of Veterinary Medicine, and ITBC provided CS-CASH researchers an opportunity to collect hazard data. Trust between American Indian community members and researchers is critical to the success of research conducted with these communities.[37,38] Many American Indian communities have been analyzed, stereotyped, and exploited by outside groups, resulting in uneasiness with nontribal members. American Indian populations may be suspicious of unfamiliar individuals who come to their community and want to conduct research.[39] Data collection would have been difficult, if not impossible, without these partnerships. ITBC invited

researchers to attend their annual conference to survey herd managers, providing a convenient location to reach these individuals. All of the partners are committed to continuing to research potential hazards, determine best practices, and ultimately implement safety and health applications for tribal bison workers.

There were limitations in this study. First, data were gathered from bison herd managers and not directly from the bison handlers. As previously described, the transient nature and accessibility to American Indian bison herders made it very difficult to directly sample these primary stakeholders. Therefore, we cannot conclude that observations by the veterinarian and perceptions of the herd managers represent a complete picture of the hazards faced by these workers.

Second, the herd manager surveys were retrospective and relied on their ability to remember details regarding the working environment and behaviors of bison herd workers, leading to possible recall bias. Third, the number of observational (10 tribal herd sites) and herd manager surveys (n = 33) was admittedly small in this pilot project. Lastly, surveying took place in a limited geographic location (North Dakota and South Dakota) preventing generalization of the findings. A full-scale project is underway at the time of this writing. This project will continue to survey for work hazards affecting tribal herd workers as well as non-tribal bison handlers in a wider geographic region.

Conclusion

Hazards faced by tribal bison workers have not been previously researched. The findings of this collaborative research are novel and provide data on exposure hazards, causes of bison handler injuries, and types of injuries incurred by tribal bison workers in North and South Dakota. This information will assist bison producers, both tribal and nontribal, in formulating and implementing best management practices to improve the health and safety of workers when handling bison. Trusted institutional partners, UNL veterinarians, and ITBC continue to use the knowledge gained from this research to improve health and safety in the tribal herd worker community. This project is an example of how institutions can collaborate to promote enduring change in a community of workers.

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Influencing Safety in Australian Agriculture and Fisheries

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ABSTRACT

Background: Improving the health and safety of those working in Australian agriculture and fishery industries is a recognized priority area for preventative activities. With Australian agricultural industries being among the nation's most dangerous workplaces, there is a need for action. While there are currently known solutions, their implementation is limited. Influential agents, i.e., people who can influence others, are important for helping engender action to enact solutions into practice. Objective: This study examines agents that influence safety behavior either negatively (barriers) or positively (facilitators), in the Australian agriculture and fishery industries. Methods: Focus groups were conducted with producers and industry representatives. Thematic analysis identified barriers and facilitators to improve health and safety. These were assessed against the Socioecological Model, which considers the various, and often intersecting, human (intrapersonal, i.e. values and attitudes, peers, familial, and cultural) factors influencing safety behavior. Results: Seven categories of human influences were identified: self, peers, family, intergenerational change, industry agents, government agents, and other. Peers (including direct managers) and family were seen to be direct influencers. Individuals signal to others that safety is valued and important. This is reinforced by experience, skill, attitudes, and behavior. Safety practice knowledge acquisition occurred via the family unit, specific training, industry, or knowledge transfer between industries. Government influence predominately focused on legislation and while the source of this influence is distant, it does influence behavior. Conclusions/Recommendations: There is a need to support comprehensive programs. These should include strengthening relationships via peer-to-peer networking, sharing information about safety initiatives, appropriate legislation, and enhancing leadership of all influencers with regard to safety.

KEYWORDS

Barriers and facilitators; farm; health beliefs; occupational health and safety; qualitative research

Introduction

Agriculture and fishery industries have among the highest rate of worker fatalities in Australia, with agriculture also identified as a priority area for national prevention activities.[1,2] The agricultural industry, which excludes forestry and aquaculture, accounted for 21% of all worker fatalities between 2010 and 2014, but employed only 2.6% of the workforce, a rate (14.8 fatalities per 100 000 workers) eight times higher than all other industries.[3] Workers' compensation data for the same period was also the highest of all industries and 59% higher than the rate for all industries, with 11 serious compensation claims made per million hours worked.[3] These workers' compensation figures likely underrepresent the amount of serious injuries and diseases present in the agricultural and fishery industries, as a large number of agricultural workers are self-employed.[3]

The Primary Industries Health and Safety Partnership (PIHSP) is a research program that falls under the auspice of the statutory Rural Industries Research and Development Corporation (RIRDC). The PIHSP provides research, development, and educational activities (RD&E) to promote safe work practices and environments and to also enhance the mental and physical health of farming and fishing industries' workers and families. The most recent PIHSP RD&E plan for 2013–2017, developed after reviewing industry need, identified that a key area of national research priority was to 'address the barriers to the adoption of improved work health and safety (WHS) outcomes'.[2] This focus acknowledged that work-related fatalities, injuries, and illnesses will not be reduced without an understanding of what prohibits the adoption and implementation of systematic hazard management

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and that behavior and attitudes are impacted by a wide variety of influences.[2,4] These influences included the industry, government, economics, resources, and the environment.[2]

The original research, which addresses this research objective of the PIHSP, focused on defining what the barriers and facilitators are to implementing safety change in the Australian agricultural and fishery industries, which has been presented elsewhere.[5] This article applies a socioecological lens to reviewing the discussions that emerged when discussing barriers and facilitators and thereby elucidating the role of human agents in the diffusion of safety change and innovation within the Australian primary industries context.[6,7] Influential agents are taken to mean people who influence the behavior of others whether that be via a direct path and as a result of a direct relationship (e.g. between a manager and employee) or indirect such that the process of influence may occur via a mediator (e.g. application of legislation and workplace adoption facilitated by inspectors).

Human interaction and behavior are dependent on the social and environmental contexts, so when behavior is examined outside of or without regard for the overarching context, there can be omissions in interpretation.[8] Utilizing a socioecological approach to examine influential agents acknowledges this complexity including both human (intrapersonal, i.e., values and attitudes, peers, familial, and cultural) and nonhuman influences (economic, political, environmental changes, etc.).[9–11] With regard to influential agents, there are likely to be commonalities across enterprises, industries, and even nations as a result of the way social relationships develop, reliance on networks, and the knowledge trading that occurs therein.[12,13] The overarching question is can influential agents stimulate behavior change with respect to health and safety and, if so, by what mechanisms.

The types of influential agents identified and utilized for safety improvements are common regardless of culture. Some examples include peers by the creation of socially supportive networks, empowering women to be vehicles for change, using role-modeling techniques with children, and if the family are proximal this is sufficiently motivational albeit not necessarily direct, i.e., live on the farm.[12,14–16]

A review of the Australian literature was undertaken and further elaborated on these international findings by highlighting that three important factors that assist in the creation of influential agents are strength of the relationship, physical proximity, and expected outcomes.[17–20] Legislation and WHS requirements are a common motivation for safety improvements, by virtue of the potential punitive outcomes that would stem from not making this mandatory change and the relative proximity of those who might note the omission to comply.[17] Likewise, women are identified as having a 'zone of influence', which aligned with enhancing safety practice but was related to visibility, such that practices differed when the farmer or fisherperson knew they were not observable by the woman/women.[18]

Small farms are common in Australia, whereby the term small is used not just to represent physical size, but considers other variables, such as if the farm serves as a source of income and if employees are present.[19] Small farms obtain farm-related information from neighbors, farmers markets, and other farm-related service providers.[19] Notably though, is how they obtain their safety information – from small rural publications and magazines, thus suggesting ways to further bolster the potential contact with influential agents and to improve the knowledge, credibility, and authority of those present within rural settings.[19] Nonhuman-based influential agents were identified as including technological advancements and engineering improvements, thus influencing safety by changes in machinery and work practices.[20] These findings are suggestive of the influential agents in the Australian context; however, it is not well established who directly exerts influence on safety behavior change related to WHS initiatives.

The aim of this paper is to explore influential human agents for improved safety practices in Australian agriculture and fishery industries. Analysis of how people can directly or indirectly influence others' safety behavior in a negative (barriers) or positive (facilitators) way is articulated.

Methods

Our original research studied the barriers and facilitators to safety change in agriculture and fishery industries, and in the current analysis, we took a qualitative approach to further explore influential

agents as reported by producers and representatives from agricultural and fishery industries in Australia.[5] Focus group discussions were the primary source of data. Details of these focus groups as they relate to the influential agents are summarized below (Table 1).[5]

Focus group schedule

A literature review of the barriers and facilitators to the adoption of WHS in agricultural and fishery practices was undertaken, which informed the development of semi-structured focus group questions (presented in Table 1).[5] A series of industry-specific focus groups was undertaken in a variety of locations across Australia (Table 1).

Participant recruitment

Determination of the potential participant pool used two related approaches: 1) the authors utilized existing contacts within commodity groups, i.e. cotton, grains, beef cattle, fisheries, sheep, sugarcane, and meat processing or 2) contact with key commodity stakeholders was facilitated by participating Research and Development Corporation commodity groups. The resulting sample drawn was a convenience sample, which used advertising of the focus group sessions and direct contact via email or phone calls from the research team with individuals in the various commodity groups to recruit participants.

The location for the focus groups was determined based on key hubs of commodity activity. Each commodity group had separate sessions to promote depth of conversation and to draw upon commodity-specific experiences and attitudes, with the only exception being a combined cotton and grain session due to the common overlap in these two commodity groups. Regardless of the recruitment method, all potential participants were given an information sheet to review prior to the session and informed consent was obtained to participate and for the session to be audio-recorded. All focus group sessions were facilitated by RF except for one led by a trained local facilitator (JT for the Bathurst session). Majority of the participants, given the recruitment method, were primary producers or those who worked within the agricultural and/fishery industries, including contractors to the industries.

Definitions

For the purposes of this research, a 'barrier' was defined as 'real, or perceived obstacle(s) that make

Table 1. Summary of literature review of barriers and facilitators in Agriculture and Fishing and focus group questions, locations, and industries.

Literature review (thematic groupings within HBM format)	Focus group questions	Industry and location of focus groups (participant numbers)
Barriers: Attitudes to change Cost Attitudes of complacency and acceptance of risk Negative social influences Perceptions of control over circumstances Facilitators: Attitudes to change Perceptions of control over circumstances Role of social networks and personal connections Best practice management systems and whole of production change Awareness and reasons for action Safety culture and credibility of safety messages	Injury experiences: Injury and near-miss experiences Health and safety specific Current approach to health and safety in business and in industry What motivates health and safety engagement in business Health and safety principles Health and safety changes over time in business and industry What has influenced these changes Health and safety future intentions for business Barriers and facilitators specific What are the barriers to the implementation of health and safety in business and industry Benefits to implementation for business and industry What would help implement health and safety initiatives Potential roles of government and industry Research required	Cotton/Grains: Moree, New South Wales, and Dalby, Queensland (n = 19) Fisheries: Cairns, Queensland, and Hobart, Tasmania (n = 18) Sugar: Ayr, Queensland, and Ingham, Queensland (n = 10) Meat and Livestock: Bathurst, New South Wales, and Brisbane, Queensland (n = 16) Meat Processing: Teleconference (n = 3)

Note: Nine focus group sessions were held, in six industries, with a grand total of 66 participants. Source: Summary of exploring the barriers and facilitators to the adoption of improved work practices for safety in the primary industries [5]

something difficult or impossible to achieve.'[5] A "facilitator" is a phenomenon that makes something easier or helps cause an action to be adopted.[5] Although not an explicit focus in this article, 'adoption' was defined as 'a decision to make use of an innovation as the best course of action available.'[7] However, who influences decision making with respect to safety improvement is the focus of the current analysis.

Thematic analysis

The focus of the current analyses was the conversations about who influences safety behaviors to provide insight into how participants construct ideas about efficacy and efficiency in terms of safety practice. Audio recordings of the focus group sessions were transcribed by a professional independent transcription service and checked by the research team. An inductive thematic analysis, guided by the socioecological framework, was conducted by the lead author in Nvivo 11, and the finalization of categories was performed via an inter-coder agreement process involving all authors.[10,21,22] The categories were *a priori* informed by the socioecological framework, with subsequent analysis determining the additional layers of influence. Agreement was high, in part due to familiarity of all team members with the content of the focus group transcripts, from previous work with the data.[5]

Ethics

Ethics approval was sought and granted from James Cook University's Human Research Ethics Committee (Application Identification: H5587). All stipulations of the data use outlined in the ethics application along with broader compliance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007), the Declaration of Helsinki in 1995, and the 2008 Seoul revision have been upheld.

Results

Nine focus groups involving 66 participants (n = 14 females; 21%) were held across Australia in 2015. There was representation across the following industries: cotton, grains, fisheries, sugar, meat and livestock, and meat processing. Participant roles ranged from owners, farm or fishing enterprise managers or contractors to WHS or general industry representatives. With the exception of one of the fishing focus group sessions, which included workers in the prawn fishing industry, the majority of the focus group participants were owners or managers. Analysis of focus group discussions using a socioecological framework focused on influential agents resulted in the identification of seven categories to describe influential human agents and associated factors for safety change; these were: self; peers; family; intergenerational influence and changes; industry agents; government agents; and other influencers. Discussion of influential human agents across the categories typically included content that identified both direct and indirect influencers, with the exception of peers, which were discussed as a direct mechanism of exerting influence.

Self

There were discussions about the need for individual responsibility for personal safety and lack of this could pose a degree of risk to others, or alternatively a high level could improve safety in the workplace either by intent or by design. In particular, it was perceived that some individuals were not fit to work in agriculture or fisheries. This was based on inappropriate skills sets, attitudes, and behaviors toward personal safety, all of which had implications for the safety of the individual and other coworkers (Quote 1, Table 2). Within fishing industry focus groups, this discussion reflected on the conditions of offshore fishing, which creates a work environment where workers are not able to obtain affective distance due to physical captivity to the work, thus potentially creating issues regarding control and consistency in behavior (Quote 2, Table 2).

It seemed that while there were some positive safety attitudes and practices that span entire industries, there were also localized versions that were fit for specific purposes, made to enhance safety in everyday practice but were examples of individuals determining their own safety course (Quote 3, Table 2).

Peers

Direct interaction with peers in the workplace was perceived to reinforce and enhance the understanding

Table 2. Quotations regarding influential human agents for improved work health and safety.

Category of influential agent	Definition and direction of influence	Quotation
Individuals	*Corresponds to intrapersonal level of socioecological framework. Individuals were discussed in terms of personal control over safety conditions and reflections on the nature of personal responsibility with regard to safety on the enterprise and were direct influence over conditions, both positive and negative.*	1. *'…sometimes it is ignorance, sometimes it is being too hasty or sometimes it is just that they don't care. But everybody, obviously the people least like that are the most employable and are probably going to get the job done better and stuff like that and everyone wants the best people they can have… You get some people who are probably a potential danger to themselves and others. But the focus I guess is on being aware…'* (Fisheries Industry). 2. *'…The big difference here [in the fishing industry] is that you don't get to walk away from people you don't like or whatever…'* (Fisheries Industry). 3. *'…it always amazed me how each farmer will go through a particular routine - they're very similar - but they've all got their own particular things for their own farm that they've geared those safety things around their own farm…they're not…getting up on a soapbox and saying, look at me - I do it better than you. Some do, but the fact is, they do know what they're doing…'* (Sugar Industry)
Peers	*Corresponds to the interpersonal level of the socioecological framework. Peers were discussed as being proximal relations that held influence in direct ways, due to the nature of interactions in the field and in everyday engagement of safety practices. It included direct managers*	4. *'…every couple of years they do their training, reflect on the issues - let's go to the workplace; how do we apply those issues here? Yeah, definitely does better, but it's not only just that interface; it's also the interaction between workers, contractors and growers in the paddock…'* (Sugar Industry). 5. *'…. If you have individuals or characters that are creating disharmony that can all lead to an unravelling of the kind of culture that we have been investing a bit in with getting teams working together and having them communicate properly about risks, talking through jobs before they happen…' (Fisheries Industry)* 6. *'…I found the same with workers too. When we first started handing out our induction forms they thought, 'We should throw these in the bin, waste of bloody time'. But after about two or three years a couple of the boys were saying, 'Can you give us a copy of that so we can change it [our approach to safety]?' - and we did that for them - and they were using it at their own places there…'* (Meat and Livestock) 7. *'…we struggle with that every season. Internally for me, is it how do I create that safety culture when I've got seasonals coming in every year…when you're bringing a person from…a zero base to our level of safety…it's how do you get that done quickly and efficiently and then make them understand it and…actually realise they're doing it because it's the right thing to do and not because the boss has said you have to do this…'* (Sugar Industry).
Family	*Corresponds to the interpersonal level of the socioecological framework. Family is the proximal relation who may or may not be engaged in the day-to-day efforts of production, but have relationships to producers and different levels of expectation and obligation regarding the importance of safety on the enterprise. In particular, children and the elderly are a focal point given their vulnerability.*	8. *'…Interesting, though, isn't it, to say your workshop should be fenced off and I think that's probably a good point with little kids running around. I come from being on the farm with kids around and my system was that they would come with us and they learnt the safety being with us. But the trend seems to be now you isolate them from those spots, so I don't know. Better not comment…'* (Cotton/Grains Industry).
Intergenerational Influence and Changes	*Corresponds to the interpersonal level of the socioecological framework, featuring a temporal element that may have impact on the direction of influence. Intergenerational change was perceived across time, relating to the core values regarding the safety of particular age cohorts.*	9. *'…Yeah, but the other big constraint I reckon is attitude. For me, with a father who has grown up in a different generation and trying to come back - and then say well we need to do things, need to document things - and he's just, why the hell are you doing that? It's different now…' (Meat and Livestock Industry)* 10. *'…I was fortunate I actually went to an ag [agricultural] college and they have a year to train someone on machinery and stuff. We don't have a lot of that anymore, where we can send young people away to get the appropriate training on a driver harvester or drive a select piece of equipment. If they want to drive a forklift, yeah they can go but in our industry if you want to work on some of that select machinery, it's on the job training. We can't take them anywhere anymore'* (Sugar Industry).

(*Continued*)

Table 2. (Continued).

Category of influential agent	Definition and direction of influence	Quotation
Industry Agents	*Corresponds to the organizational level of the socioecological model. Industry agents had both direct and indirect influence, depending on the focus of conversations – industry-based field safety officers were seen as direct influences, indirect influences were industry knowledge sharing in more passive terms.*	11. *'M1: . . .You can't just say there's no culture of it [safety] and expectations are we'll never have it. Unless you put people on the ground there to develop that culture, you'll never ever create it.* *M2: . . .[Safety Officer name] was able to give them the skills and processes to do some of the stuff that they needed to do. We had people coming to us talking about the risks around their operations. . .[He] was able to. . .do. . .assessments and the other thing that my mate [Safety Officer] did for the industry, was to. . .make representations on behalf of the industry to government as well'* (Sugar Industry).
Government Agents	*Corresponds to the policy environment level of the socioecological model. Legislative and regulatory requirements (passive agents) showed indirect influence, while the surveillance/ advice/enforcement activities of regulators showed more direct influence over safety actions on the enterprise.*	12. *'. . .the main consultants that have been available are from Workplace Health and Safety Queensland, and certainly it's an issue with most growers that say, well how can the person that's going to police me be helping me out, because if I tell them I'm doing something wrong, I'll get the chop straight away'* (Sugar Industry) . 13. *'. . .so I think from an individual establishment perspective, whether this directly comes from a regulator and/or the government, is that there should be some. . .carrot approach to give benefit to those that are preforming well. For those that aren't. . .I don't think so much of the stick, I think. . .more. . . assistance*' (Meat Processing Industry). 14. *'. . .now, I know they have in place a system. . .where small businesses under so many employees could actually [ring up] WorkSafe to come out and give them a bit of a hand, so that they could put together a health and safety system. When I saw that in place I went, hey that's fantastic that they sort of offer that service'* (Meat Processing Industry). 15. *M1: '. . .I was the only designated safety manager in [State name] in the [Industry Organisation].* *M2: '. . .That was a really good model for [growing region], and a lot of what we've got in farming in the [growing region] is generally the good work [Safety Manager] has done. . .'* (Sugar Industry)
Other Influencers	*Other influencers included public perceptions of agriculture and fishery industries generated by media and social media. These were passive agents, but some industries had created active agents of these influencers, engaging directly with the creation of messages about industry safety levels.*	16. *'. . .so there's always a perspective that it's easy to generalise with farmers. . .I think it's like you see someone gets hurt on a four-wheeler; oh there are those farmers again. It's mostly - it's not farmers at all - it's someone down the beach. . .'* (Sugar Industry). 17. *'. . .we've already engaged with best management practice programs like [Program name]. That program there is basically to demonstrate to community and government how well growers actually do perform in particular areas across the spectrum of farming, and best management and practice. . .'* (Sugar Industry)

of WHS in the work environment, in the form of translation from theory to practice (Quote 4, Table 2). Positive attitudes and practices were reinforced through training undertaken by industry leaders that inspired practical ways of implementing safety ideas in the field. Conversely, it was identified that negative attitudes toward safety influenced the safety in the enterprise (Quote 5, Table 2). However, leadership via positive attitudes and approaches to safety was seen as a way to change culture. This discussion around leadership focused on how positive attitudes led by the industry influenced the implementation at the enterprise level of workplace health and safety, demonstrating the value of team-based (peers) approaches to safety management (Quote 6, Table 2). However, impediments for creating a 'culture of safety' using peer-to-peer interaction include the high proportion of seasonal staff and their levels of experience or training (Quote 7, Table 2).

Family

There were some discussions that represented farmers as being safety conscious due to the direct influence of family. This was partially credited to the family-oriented nature of this enterprise over generations. The presence of children and the elderly meant that safe practice was imperative, and the ability to find solutions to safety problems within the family farming unit was a highly valued social norm (Quote 8, Table 2).

Intergenerational influence and changes

There were repeated indications that attitudes to safety had changed over time as a result of an intergenerational shift such that safety is now more highly prioritized. This was being influenced by a complex array of factors including: education of younger producers; return of workers from industries with well-entrenched safety practices (e.g. mining); increased availability of safety advice and personal protective equipment (PPE); and greater awareness of risks in their industry. However, it is difficult to separate whether this differential attitude toward safety is also related to heightened personal legal risks if safety is not upheld in a workplace (Quote 9, Table 2).

Agricultural and technical colleges were also mentioned as a key way to educate young farmers about safety practice. However, the downturn and closure of these colleges were identified as being detrimental to improving health and safety as there is no longer a space for dedicated learning (Quote 10, Table 2).

Industry agents

Industry representatives in the focus groups frequently had leadership or communication engagement roles for their industry. Their role in liaising with decision makers (e.g. farm owner/boat owner/manager) and the broader community was discussed as a way to influence safety practices; helping them understand and adopt safety was perceived as part of their contribution to their industry. For some, the ability to act as translators of policy into practice was a critical role that took most of their attention, and was attributed as being of value by community members (Quote 11, Table 2).

Government agents

Due to legislative and regulatory requirements, the perceived administrative burden of compliance was a barrier to safety implementation. This was compounded by the enforcement of these regulations in potentially punitive ways. There was suspicion of interactions with regulatory staff or accepting assistance with safety compliance from government bodies (Quote 12, Table 2).

However, it was also reported that more effective enforcement of the legislation relating to safety practice would be an important factor in creating change. In particular, the encouragement of good practice among those who were compliant, and the application of stated enforcement actions and assistance for those who did not comply were reported as a facilitator for change (Quote 13, Table 2). Others felt that the provision of impartial advice for safety implementation and partial assistance with the financial costs from government agencies would facilitate uptake (Quote 14, Table 2).

The loss of field or extension personnel that had previously been employed by the government or industry to assist farmers and fishers was reported as restricting safety improvements. Typically, these

personnel were regarded as highly influential in the process of translating legislative requirements into everyday practice and providing assistance at the local level (Quote 15, Table 2).

Other influencers

Other influencers included the media (including social media) and reporting of statistics related to safety. The social representation in media of workplace deaths and incidents in agriculture and fishing was a source of frustration for many. They expressed a sense of hypocrisy in the deficit language used to discuss these incidents, which left them feeling targeted for the incidents that occurred in the workplace (versus representations of incidents that occur in society at large) (Quote 16, Table 2). Some industries reported engaging with social media and the creation of websites to promote good safety practices, to begin challenging these broader societal perceptions.

The introduction of safety systems, including a minimum set of criteria (i.e. quality assurance systems), was viewed as positive. This was perceived as a way to produce evidence of effective and efficient safety changes, and as influential on the creation of safety cultures (Quote 17, Table 2).

Discussion

Understanding the barriers and facilitators is crucial to improving safety in agricultural and fishery industries.[5] A key aspect to this is the human aspect of influence.[23] In this paper, we explore discussions that showed that human influential agents have an impact on safety in different ways, at different times, on particular issues. It is clear that influential human agents can influence health and safety behavior in others, although the extent to which specific barriers and facilitators are influenced by human agents needs further testing, as our data does not answer this. What the data does show are pathways for exploring how people can directly or indirectly influence others' safety behavior in a negative (barriers) or positive (facilitators) way.

There were seven influential agent categories that were identified and parallel the levels of influence typically identified in socioecological models – self (intrapersonal), peers (including direct managers) and family (interpersonal), intergenerational change over time (interpersonal), industry agents (organizational) government (policy environment), and other influencers such as media and statistical reporting.[10] Other influences included the role of media and social media in the portrayal of messages about these industries. These influential agents should be considered within the contextual environment. In conversations across industry groups, the role of human influential agents emerged as both a barrier and a facilitator of change, in different ways, at different times. These distinctions are important insights outlined below, which require further testing.

Developing a safety culture

There were discussions in all groups about social and culturally normative behaviors, plus attitudes and the observed changes that have occurred over time. These changes are perceived to have been influenced by agents at the individual, peer, family, intergenerational, industry, and government levels. The role of significant others in peer groups and family is highly valued in terms of their influence over the implementation of safety practices, but research notes this influence can flow both ways.[15,18] This is despite there being limited opportunities in agriculture and fishing for networking with others to create innovative practice, due to the fact that in most industries dedicated safety officers to lead such networks in dedicated discussion toward safety were in limited supply, or no longer employed at all. While these agents do not have to be present for changes to occur, it may be that they have an influence in the ways that change is adopted, and the timeliness of innovation and adoption. This needs further investigation. Trusted relationships of producers with such field agents and trainers who had industry experience enabling them to provide practical advice were important to promote decisions on the relative value of safety innovations and legislative change. The value of these relationships has been noted to be especially important on small enterprises; however, the relative use of trainers and/or field or extension agents as information sources, and thereby influencers, has been noted as being limited in some international studies.[19,24–27]

Engagement with social media and other media to influence external attitudes toward safety is a recent development in these industries.[28] It may be that the

continued use of social media as a platform for sharing the successes of individual and industrial-level innovations around safety will go some way to producing this supportive environment. However, it is likely that this support will need to be localized, and incorporate peer-to-peer interaction.

Drivers of change

Farmers are driven to make changes on their enterprise by a range of factors such as legislative requirements, an increased intergenerational awareness of safety, and a desire to improve performance.[17,29] These factors were also identified in this study as influential facilitators of change. However, it is important to recognize the critical role that networks of connected peers have in the transmission of knowledge and establishment of cultural normative behaviors, although research has noted that this process can be hampered by geographical and social isolation, which is common in agriculture and fisheries.[4–32] Peer groups will be important as they facilitate the sharing of local knowledge that is context sensitive and makes intuitive, practical sense. By sharing these examples across the industry, they may also be adapted to fit other local contexts.[6,8,33]

Benchmarking

There is a need within these industries to showcase the best safety solutions, and even individual enterprises where solutions have been effectively implemented to establish reasonable benchmarks for what people can achieve. It will be necessary for industry representatives (guided by legislative requirements) to have conversations with producers in establishing evidence-based aspirational goals for safety in agriculture and fishing. More engagement with the industry representative agencies and individual farmers and fishers when structuring goals at the national level may assist in the establishment of realistic benchmarking criteria.[3,34]

Leadership

Leadership can occur at all levels; however, representative industry groups must have a clear and strong role. In addition, those with management responsibilities and those who achieve a high level of safety solution implementation can also be engaged in this process. Exploration of leadership, empowerment styles, appropriate benchmarking, and monitoring for industries improves understanding of the ways that local producers seek support and require support mechanisms to function, so that they may share their achievements and network to find enhanced solutions to emerging safety issues.

While there were other influences in decisions about safety (including cost, time, and difficulty to implement), the role of influential agents at the point of conceptualizations about susceptibility and perceived self-efficacy to make changes is at a critical juncture.[5] Understanding this in the creation of training and targeted leadership development may enhance such endeavors. It is unclear the degree of strength each of these influencers hold, in their own right, or relative to the others. This may indicate the need for further research in this area.

Implications for practice

Through an understanding of who facilitates or inhibits safety improvements, the following is proposed. Two underutilized influential agents are peers (excluding management) and family, due to the direct nature of the relationship. Peers and family can be utilized to convey safety-related information and to reinforce safety practices; however, they can also have the opposite impact as well. Furthermore, a consideration of the physical environmental and often interconnected challenges present in primary industries such as isolation, captive to their peers in the workforce (i.e. limited ability for external interactions), and mental health are issues that influence the nature of relations and require further elucidation. Use of field agents with expertise in industry-specific WHS requirements (individuals that offer advice without the potential risk of enforcement of legislative requirements such as can occur with a government inspector) has been identified as a way to build capacity, via the use of partnerships among the government, industry, and safety experts.[24] Field agents as an influencer also require greater exploration about how formalized networks are potential conduits to improved health and safety practice.

Limitations

It is possible that there was a degree of self-selection bias toward those who are/perceived to be already engaged with issues of safety and their willingness to participate in the focus groups. The use of a convenience sample based on known individuals (to the researchers or within commodity groups) has likely inadvertently meant that the participants themselves are influential agents within their respective locality-based commodity groups. Whether this has skewed the resulting discussions is unknown, but presents a point for reflection. Social desirability bias can also be considered a limiting factor in group-based, face-to-face research methods. The focus group question design was open ended, and while focused on particular topics, avoided leading questions, and was led by experienced facilitators (see Table 1 for question themes). The data from focus groups that included influential agents were solicited in larger conversations regarding the barriers and facilitators to the adoption of improved health and safety practices and as such it is not known whether this impacted the type of influencers discussed.

Conclusion

Exploration of the barriers and facilitators to safety change, with a particular focus on the human agents of influence in the Australian agricultural and fishery industries, illustrates the critical importance of relationships. The influence of interpersonal-level factors impacted in both direct and indirect ways, but ultimately it was through valued relationships among actors in agriculture and fisheries that changes were facilitated or blocked. This included influential agents or mechanisms such as leadership through peer-to-peer interactions and training, the presence of vulnerable others, and impartial support and assistance from industry and government agencies regarding changes at the industrial and legislative levels. However, in order for innovation in safety approaches to flourish, there is a need to support producers in sharing information about successful safety programs and initiatives, and enhancing leadership opportunities for producers with regard to safety.

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North Carolina State Agencies Working to Prevent Agricultural Injuries and Illnesses

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ABSTRACT

Over the past 25 years, the North Carolina Departments of Labor, Agriculture and Consumer Services, and Health and Human Services have worked with farmers, farmworkers, commodity and trade associations, universities, and cooperative extension agents to develop programs to decrease the occurrence of injuries and illnesses among agricultural workers and their families. The Bureau of Agricultural Safety and Health in the North Carolina Department of Labor helped craft the Migrant Housing Act, created the Gold Star program, and developed numerous projects promoting rural highway safety and farm safety. The Structural Pest Control & Pesticides Division in the North Carolina Department of Agriculture & Consumer Services administers programs funded by the Pesticide Environmental Trust Fund (PETF), including the Pesticide Container Recycling Program, Pesticide Disposal Assistance Program (PDAP), and Soil Fumigation Training. The Occupational and Environmental Epidemiology Branch (OEEB) in the North Carolina Department of Health and Human Services developed public health surveillance programs for pesticide incidents and carbon monoxide poisoning. These projects, programs, and policies demonstrate the work that North Carolina state agencies are doing to improve the health of agricultural workers and their families.

KEYWORDS

Agriculture; illness; injury; pesticides; safety

Introduction

Over the past 25 years, the North Carolina Departments of Labor, Agriculture and Consumer Services, and Health and Human Services have worked with farmers, farmworkers, commodity and trade associations, universities, and cooperative extension agents to develop programs to decrease the occurrence of injuries and illnesses among agricultural workers and their families. By addressing several spheres of influence (policy, institution/organization, community, farmers/farmworkers/families), these programs improve the health of agricultural workers and their families (Figure 1). In this article, we describe various programs that address each sphere of influence.

North Carolina Department of Labor, Bureau of Agricultural Safety and Health

The combined efforts of the North Carolina Legislature, the elected North Carolina Commissioners of Labor, and working groups have formed alliances over the past 25 years with the staff of the Agricultural Safety and Health Bureau of the North Carolina Department of Labor. These efforts have effectively promoted and continue to promote a safe agricultural workplace.

Migrant housing

In the 1980s, migrant worker advocates found the housing supplied to migrant farmworkers substandard and determined that the agencies inspecting and authorizing the housing were not performing their official duties. In 1989, the North Carolina Legislature passed the Migrant Housing Act of North Carolina, G.S. § 95–222-229, establishing minimum standards for grower/operator-provided agricultural worker housing. The Migrant Housing Act requires that any person owning or operating a housing unit for migrant workers and their dependents, whether one or more migrants,

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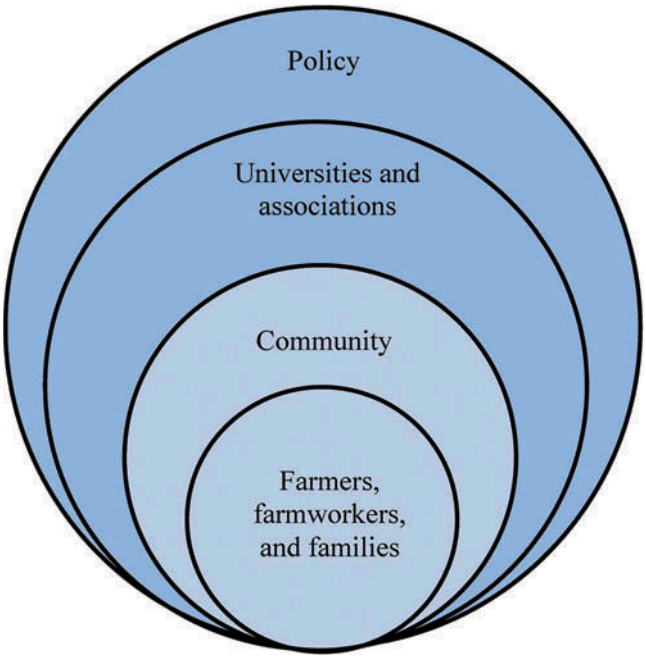

Policy: Migrant housing standards, N.C. Department of Motor Vehicles driver's handbook and driver exam questions, OSHA rules and regulations, pesticide rules and regulations, creation of Pesticide Environmental Trust Fund, soil fumigation training, pesticide incidents urveillance, carbon monoxide poisoning surveillance.
Universities and associations: Universities funded by the Pesticide Environmental Trust Fund for agromedicine programs, collaboration between state agencies and universities for education and research on agricultural issues, commodity and trade associations (e.g. North Carolina Agricultural Aviation Association, North Carolina State Beekeepers Association), Cooperative Extension Service.
Community: Projectsf unded by the Pesticide Environmental Trust Fund (e.g. Americorps), Pesticide Container Recycling Program, Pesticide Disposal Assistance Program, farmer and farmworker training (e.g. pesticide handling, prevention of heat-related illness), healthcare provider training on pesticide toxicity.
Famers, farmworkers, and families: Individual consultation on health and safety issues.

Figure 1. An applied social-ecological model for prevention of agricultural injuries and illnesses.

register with the North Carolina Department of Labor, and have the housing inspected prior to the migrants moving in so that corrections needed can be made without citations or penalties issued to the grower/operator, since there is no exposure to the hazards that must be corrected.[1]

In 1992, the Gold Star program was implemented to recognize growers who go above and beyond the minimum housing requirements for migrant housing. This program provides a vehicle for collaboration and communication between the grower community and the inspection staff with the North Carolina Department of Labor.[2]

Rural highway safety

At a Gold Star meeting in 1998, the growers indicated traffic on rural roads was their most serious safety issue.[3] At the time, only 46% of North Carolina crashes occurred on rural roadways, but the traffic fatalities in rural areas were four times greater than the traffic fatalities in urban areas.[4] In collaboration with the Gold Star Growers and North Carolina State University Center for Urban Affairs and Community Services, a survey was created to better understand the highway safety problems. The agricultural respondents called for a law that would mandate the use of the slow-moving triangle, recommended that flashing lights be used on farm equipment travelling on rural roads, and determined the root cause of the problem was lack of respect for other drivers and increased speed of other drivers. The highway safety program "Light and Reflect" was created to address these issues.[5] All registered growers received one Slow Moving sign for their farm tractor used on public roadways, and a slide presentation was created with North Carolina rural road safety facts. Information on farm equipment was added to the North Carolina Driver's Handbook,[6] since no information was available there, and three questions involving farm vehicles were added to the North Carolina driver's test. The Light and Reflect project was replicated by the North Carolina Cooperative Extension and the North Carolina Farm Bureau.

The rural road safety project was extended to Spanish-speaking farmworkers.[7] The Agricultural Safety and Health Bureau devised a skit illustrating the hazards of drinking and driving and the importance of seat belts and driving within the speed limit,[8] and they created bilingual materials to emphasize correct driving practices.

Farm safety projects

With the assistance of the Agricultural Safety and Health Council, bilingual training was initiated for farmworkers in the Christmas tree industry. Workers received hands-on training on chain

saws, balers, tractors, and other farm equipment used to plant and harvest Christmas trees. In 2005, four agricultural workers died from heat stroke in North Carolina.[9,10] The Agricultural Safety and Health Bureau conducted fatality investigations and issued citations to growers who failed to provide a safe workplace. To address this issue, the Bureau produced heat-related materials in English and Spanish and expanded on-farm training to include a training module on the prevention of heat stress and heat stroke.

To expand their safety efforts, the Agricultural Safety and Health Bureau studied farm injury data provided by workers' compensation carriers and met with insurance groups to discuss farm injuries in North Carolina. In 2007, the Agricultural Safety and Health Bureau and the North Carolina State University Department of Communication Services filmed a bilingual DVD on farm safety with the goal of reducing farm injuries and accidents. Funding was provided by grower organizations, insurance carriers, and the North Carolina Agromedicine Institute of East Carolina University. The DVD targeted the most common causes of farm accidents and fatalities in North Carolina: forklifts, tobacco harvesters, tobacco balers, and heat stress. The on-farm training methods and safety DVDs are now being used across the Southeastern United States, sponsored and promoted by the tobacco industry, which saw that an effective safety program produces positive results.

North Carolina Department of Agriculture & Consumer Services, Structural Pest Control & Pesticides Division

The mission of the Pesticide Section of the North Carolina Department of Agriculture & Consumer Services (NCDA&CS) Structural Pest Control & Pesticides Division is to protect the public health, safety, and welfare, and to promote continued environmental quality by minimizing and managing risks associated with the legal use of pesticides through administration and enforcement of the North Carolina Pesticide Law of 1971 (Chapter 143, Article 52, of the General Statutes of North Carolina, as amended through 2014) and pursuant regulations adopted by the North Carolina Pesticide Board.[11] Several projects and long-standing programs administered by the Division promote agromedicine, worker safety, public health, and environmental quality. These include short-term projects funded through the Pesticide Environmental Trust Fund (PETF), and ongoing programs for pesticide container recycling, pesticide disposal assistance, and certification and training of farmers and other private applicators using soil fumigants. In addition, the North Carolina Pesticide Board has created administrative rules to address concerns from farmworkers and community members about potential misapplication and misuse of pesticides.

Farmworker projects funded by the PETF

The PETF was created by statute in 1993 and funded through assessments paid annually by companies registering pesticide products in the State.[12] The PETF, averaging over $450,000.00 annually in collections,[13] provides funding to East Carolina University, North Carolina State University, and North Carolina A&T University for collaborative research, education, and outreach to improve the health, safety, and quality of life for rural North Carolinians; and for environmental programs administered by NCDA&CS, including pesticide disposal assistance, container recycling, and other pesticide environmental projects approved by the North Carolina Pesticide Board. Examples of farmworker-related projects funded by the PETF from 1993 to 2011 include toolkits and training programs for farmworkers and healthcare providers on pesticide safety and illness prevention; a child health pesticide epidemiology study; research on pesticide metabolism; and fact sheets for farmers on the most frequently used pesticides by crop type, adoption of Integrated Pest Management principles, and how to design an inexpensive pesticide storage, mixing, and loading facility.

Pesticide container recycling program

In response to farmers' concerns about how to properly dispose of empty pesticide containers and packages, the NCDA&CS Pesticide Container Recycling Program was developed in 1995 with

funding from the PETF. The Program funds efforts for farmers and commercial applicators to participate in the recycling of plastic pesticide containers by transporting their clean, triple-rinsed empty pesticide containers to collection sites that are established by county agencies.

Since 1995, over 7 million pounds of pesticide containers have been recycled. Currently 68 out of 100 counties are participating in this recycling program. The recycled plastic is sold to companies that make industrial products, such as agricultural drain pipes, highway sign posts, and industrial pallets.

These grants have enabled counties to create and enhance pesticide container recycling programs for farmers and commercial applicators, which reduces the burden on landfills, protects human health and the environment by reducing the threat of improper rinsing and disposal, and ensures the user is in compliance with state regulations that prohibit the burning or dumping of pesticide containers.

Pesticide Disposal Assistance Program (PDAP)

Established in 1980 as the very first program of its kind in the United States, the PDAP is a non-regulatory, consumer services program providing cost-free assistance to North Carolina farmers and homeowners by managing and supervising the safe collection and lawful disposal of banned, outdated, or unwanted pesticides. The PDAP collects an average of approximately 150,000 pounds of pesticides each year and has exceeded 3.4 million pounds since its inception. The program actively protects human health and environmental quality by disposing of pesticides that may otherwise contaminate the surface water, groundwater, soil, and air through spills, improper disposal, and illegal burning.

Soil fumigation training in North Carolina

In May 2009, the United States Environmental Protection Agency (EPA) issued new requirements for soil fumigants, including new safety measures to increase protections for agricultural workers and bystanders—people who live, work, or otherwise spend time near fields that are fumigated. [14] These measures were intended to establish a baseline for the safe use of soil fumigants throughout the United States, reducing fumigant exposures and improving safety. By 2013, soil fumigant users were required to complete an EPA-approved online training or attend an NCDA&CS-developed, EPA-approved North Carolina in-person training option. Moving forward, the North Carolina Pesticide Board now requires by rule both a commercial licensing category and a farmer certification subclass specifically for soil fumigation, which requires passing the North Carolina state-specific soil fumigation examination and attending continuing education.[15] To date, more than 1,050 fumigant users have been trained, certified, or licensed in North Carolina.

North Carolina Department of Health and Human Services, Division of Public Health

The Occupational and Environmental Epidemiology Branch (OEEB) of the North Carolina Department of Health and Human Services Division of Public Health is the state agency that conducts health risk assessments, noninfectious disease surveillance, and industrial hygiene consultation to reduce and prevent illness, injury, and death from exposure to environmental chemicals. OEEB established public health surveillance programs for pesticide incidents and carbon monoxide poisoning and provides subject matter expertise when chemical exposures occur in an agricultural setting.

Pesticide incident surveillance

Due to increased concern about potential pesticide overexposure in both occupational and nonoccupational groups and because North Carolina is a large agricultural producing state, funding was obtained to develop a pesticide surveillance program based in the OEEB. In 2006, a law was passed in the North Carolina General Assembly requiring healthcare providers to report any confirmed or suspected case of acute pesticide-related illness or injury to the OEEB or the Carolinas Poison Center.[16] OEEB developed a working relationship with the Carolinas Poison Center to report pesticide cases to OEEB. Direct calls from the public (e.g. community and migrant health center outreach workers, legal aid, individual citizens) reporting exposures are also entered into the surveillance system. OEEB

developed a memorandum of understanding with the North Carolina Department of Agriculture and Consumer Services to share information on cases where adverse human health effects were reported.

From 2007 to 2012, 5,957 reports of acute pesticide illness or injury were received, of which 2,425 were classified as definite, probable, possible, or suspicious for pesticide exposure.[17] Of the 10% of cases that were occupational exposures, 25% were among farming, forestry, and fisheries workers. Detailed information is obtained on the occupational exposure cases such as class of pesticide, activity at the time of exposure, equipment and application target, use of personal protective equipment, and symptoms reported. These data are used to educate various at-risk groups on pesticide safety, including farm operators, cooperative extension agents, private applicators, structural pest management professionals, migrant and community center outreach workers who work with farmworkers, agricultural students, and aerial pesticide applicators. Healthcare providers who may see farmworkers are trained about the recognition and management of pesticide exposures.

Carbon monoxide poisoning surveillance

In August 2013, OEEB was involved in the public health response to a carbon monoxide poisoning incident on a western North Carolina farm that left one employee dead, one employee seriously injured, and sent 16 responders to the hospital.[18] This incident led to several public health initiatives to improve the surveillance of carbon monoxide poisoning cases and prevent carbon monoxide poisoning on farms.

In December 2013, OEEB staff initiated a statewide carbon monoxide poisoning surveillance program to help stakeholders identify populations at risk of carbon monoxide poisoning and guide intervention and prevention strategies. Staff sends out monthly and annual surveillance reports that provide information on emergency department visits, poison center calls, and deaths related to unintentional, non-fire-related carbon monoxide poisoning.

In the spring of 2014, staff with OEEB's Occupational Health Surveillance Program collaborated with the N.C. Agromedicine Institute to develop outreach materials in English and Spanish to prevent carbon monoxide poisoning on farms. These materials were disseminated to stakeholders through radio stations, cooperative extension centers, farm/grower commodity associations, the Southern Farm Show, and sister state agencies.

In December 2016, the North Carolina Commission for Public Health adopted an amendment requiring physicians to report all cases of work-related carbon monoxide poisoning to OEEB. This new requirement will allow OEEB to gather more complete information about carbon monoxide incidents on farms and in other workplaces, including the source of exposure, the circumstances surrounding the incident, and the demographic characteristics of the exposed workers, which will enable staff to develop targeted prevention and outreach initiatives.

Conclusion

The North Carolina Departments of Labor, Agriculture and Consumer Services, and Health and Human Services have worked with farmers, farmworkers, commodity and trade associations, universities, and cooperative extension agents to develop programs to decrease the occurrence of occupational injuries and illnesses among agricultural workers and their families. These agencies have also worked with legislators to craft laws, rules, regulations, and policies to ensure these agricultural workers are protected and to also protect the environment where these individuals work. Through the development of surveillance programs as well as feedback from individuals involved in agricultural operations and professionals in the field of agricultural safety and health, these agencies continue to keep abreast of the injuries and illnesses resulting from exposures on the farm.

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Engaging Agribusinesses: Feasibility and Cost of an ATV Safety Poster Project

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ABSTRACT

Objectives: All-terrain vehicle (ATV)-related deaths and injuries continue to be a significant problem. Influential change agents such as agribusinesses could be important partners for improving safety behaviors among rural ATV users. Our objective was to determine how effectively an injury prevention project could engage agribusinesses through the postal service and to assess their willingness to display a safety poster. Methods: One thousand two hundred forty-four agribusinesses received an ATV safety poster and a postcard survey by mail. A randomized sampling of these businesses was surveyed by telephone 4–7 weeks later. Telephone survey questions included whether they recalled receiving the poster, and if so, whether, where and how long the poster was displayed. Results: One hundred six postcards were returned. Of the 192 eligible business persons contacted by telephone, 89% agreed to participate. Approximately one-third of telephone survey participants recalled receiving the poster. Among these, 81% with walk-in customers posted it, and 74% still had it displayed 1 month later. Of participants who did not recall receiving the poster, 83% stated they would have displayed the poster. The cost of displaying each poster in a business was 16.6 cents/day during the first month. Final costs/day would be much less because of continued display. Conclusion: A high percentage of agribusinesses displayed or would have displayed an ATV safety poster, and most displayed it beyond 1 month. Unfortunately, participant recruitment via postal delivery alone was challenging. Nevertheless, mass mailing of injury prevention materials to be displayed in the retail setting may be a low cost method for raising safety awareness.

KEYWORDS

Agribusiness; all-terrain vehicle; farm; injury prevention; rural

Introduction

Deaths and injuries associated with all-terrain vehicles (ATVs) have been a significant problem in rural areas for decades. Riding these vehicles is especially concerning for youth, as children under 16 years-of-age have a 12 times greater risk of injury as compared to older adults.[1] In fact, more children in the United States each year are killed while riding ATVs than in crashes related to bicycles.[2] A number of factors contribute to this increased risk to youth including lack of training and experience, riding as or with a passenger, operating adult-size vehicles, riding on public roads (both paved and unpaved), lack of helmet use, and physical and mental immaturity.[3–10]

Many families own or have access to ATVs in rural areas, especially on farms.[11] A study of over 4,600 Iowa school children 11–16 years of age found that 78% from rural areas had ridden on an ATV, with nearly two-fifths reporting at least weekly use.[12] Of those that had been on an ATV, 57% reported having been in at least one crash (rolled over, had a collision, or was ejected) in their lifetime. Other studies of rural and agricultural groups have found similarly high percentages of youth ATV exposure.[6,11,13–16] Although children and teens do operate ATVs for occupational purposes, a majority of their riding is recreational.

Rural states have a large number of agribusinesses whose customers frequently own or drive ATVs. Therefore, these businesses are potentially trusted places to provide ATV injury prevention information to the target audience. Many safety programs often fail to take advantage of influential agents of change that could positively impact their project.

Agribusinesses have traditionally been supportive of many farm-related health and safety initiatives. They have played an important part in the financial support of many farm safety organizations including

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Farm Safety for Just Kids[17] and Progressive Farmer Farm Safety Day Camps.[18] Major agribusinesses contributed more than a million dollars to the National FFA Foundation in 1997 to implement Partners for a Safer Community, which included a component specifying that local agribusinesses encourage implementation of the program.[19] Leaders of agribusinesses were among the founding members of the Agricultural Safety and Health Council of America.[20] Moreover, agribusinesses have often been important developers and distributors of information and teaching tools on farm safety topics.[21] Thus, we believed agribusinesses at the local level would be interested in helping share an ATV safety message with their customers and could be a strong partner in reaching our goals.

The purpose of this project was to provide ATV safety information to a large number of people as economically as possible. To accomplish this goal, we mailed ATV safety posters to Iowa agribusinesses and encouraged the businesses to post them. This study was performed to determine how effectively an ATV injury prevention project could reach and attract the attention of a large number of agribusinesses through the postal service and to assess their willingness to display an ATV safety poster in the workplace.

Methods

An ATV injury prevention poster was designed and printed (Figure 1) as part of a collaborative effort by the Iowa ATV Injury Prevention Task Force (https://uichildrens.org/health-library/all-terrain-vehicle-atv-safety). Iowa farm supply stores, feed stores, and farm equipment dealers were identified through a search of yellowpages.com in May 2009 and their telephone numbers and

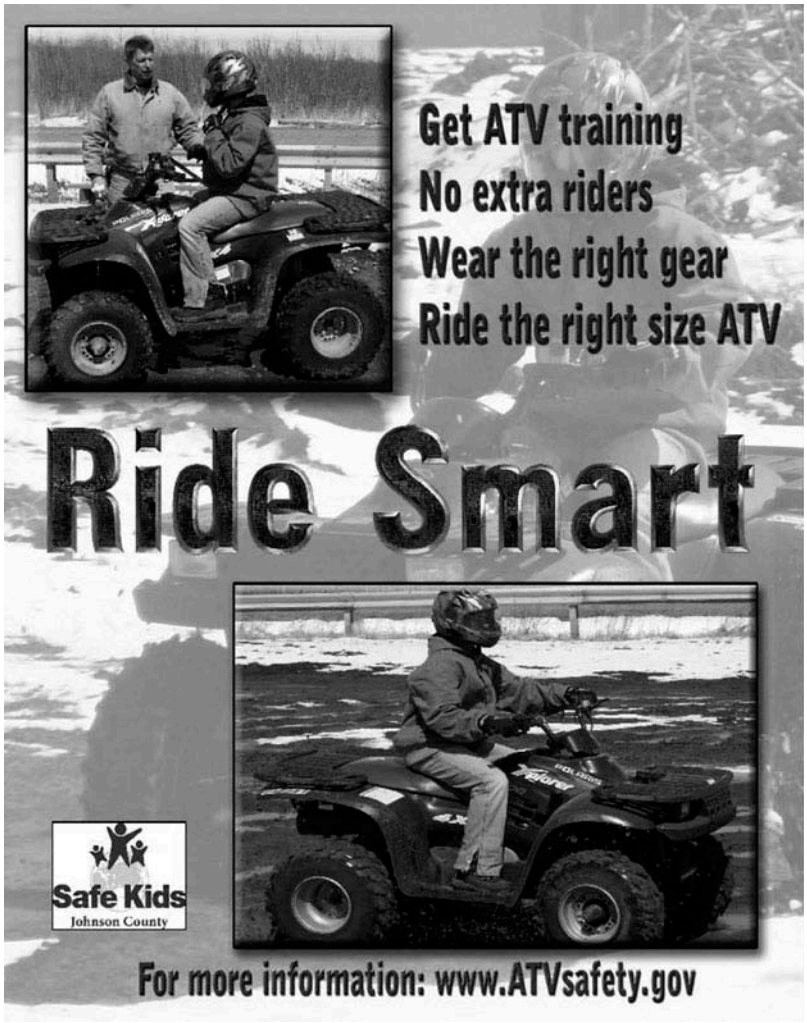

Figure 1. ATV safety poster mailed to agribusinesses.

addresses were compiled. Duplicate businesses and listings most likely not to have in-store customers were removed. The University of Iowa Institutional Review Board approved this project.

The ATV safety poster (11" × 17") was mailed to a total of 1,345 agribusinesses with "Address Service Requested" as we wanted to verify that our posters arrived at their destination. The U.S. Postal Service notified us via postcard that 28 businesses had a new or different address, and that the mailing had been forwarded to the appropriate location. However, 101 posters were returned as undeliverable with no additional address information. The reasons for the inability to deliver included that there was no mail receptacle at the address, no such address existed, the address listed was insufficient, and the business no longer existed. In all, 1,244 posters (92%) were successfully delivered by mail.

Along with the poster, the mailing included a cover letter and a postage paid pre-addressed postcard with a brief survey for feedback. The cover letter informed the business of the high number of ATV injuries that are occurring and the importance of ATV injury prevention. The letter asked the business to participate in our project and to display the poster in a prominent location. They were also requested to send back the project evaluation postcard which had several questions about the project including whether they displayed the poster and if they had any comments. See Table 1a for postcard survey questions.

All agribusinesses with a deliverable address were then numbered and randomized. The businesses were called in the order of their numbering (from 1 to 214) 4–7 weeks after the posters were mailed and asked to participate in a telephone survey. Eligible study subjects were the owner or a manager of the business; all others were excluded. Businesses were periodically called again until a response was received and an eligible subject was contacted, or the study enrollment ended. The goal was to enroll 10–15% of those businesses that received the poster. Verbal consent was obtained over the telephone via a script.

Survey questions included whether they recalled receiving the poster, and if so, whether, where, and how long the poster was displayed. See Table 1b for telephone survey questions. Comments regarding the project, including its effectiveness and how it could be improved, were also solicited. Of the 214 agribusinesses called, an individual answered the phone at 95% of them. Of those 204 businesses, an eligible subject was available at 192 (94%) and 171 of the eligible subjects (89%) consented to participate.

Table 1. Survey tools. (a) Postcard survey mailed to agribusinesses along with an ATV safety poster, $N = 106$ postcards returned. (b) A telephone survey administered to a random sample of agribusinesses 4–7 weeks after poster mailing, $N = 171$ survey participants.

a. Postcard survey mailed with poster

1. Will you display this poster in your business? Yes, No, We are not a business with walk-in customers
2. If yes, where will you display the poster? On or near entrance door, Near counter, Bulletin board near entrance, Wall in the store, Other (Describe)
3. Do you believe this is a worthwhile project? Yes, No, Maybe
4. Do you think the poster will make people think about ATV riding safety? Yes, No, Maybe
5. Do you think the poster will change ATV riding safety behavior? Yes, No, Maybe

Please provide Comments/Suggestions

b. Phone survey of randomized sample

(1) Do you recall receiving in the mail an ATV Safety Poster? Yes, No
(2) Was the ATV Safety Poster ever posted in your business? Yes, No
(3) If yes, where in your store was the poster displayed?
(4) Is the poster still displayed? Yes, No
(5) Did you receive any comments or overhear any comments with regard to the ATV Safety Poster from customers? Yes, No
What were they?
(6) Did you receive any comments or overhear any comments with regard to the ATV Safety Poster from employees? Yes, No
What were they?
(7) Do you have any comments yourself about the project? Yes, No
What are they?
(8) Do you have any ideas about how to improve such a project? Yes, No
What are they?
(9) How would you rate the effectiveness of this project to reach a large number of people about ATV safety? Rate the effectiveness from #1–5 with #1 being very effective and #5 being not effective at all? 1, 2, 3, 4, 5

For analysis, the agribusinesses were classified by location as being "Rural" or "Urban." Rural businesses met one of the following criteria: (a) located in a county not designated as part of a Metropolitan or a Micropolitan Area (MA) by the Office of Management and Budget,[22] or (b) located in a census tract within a MA with a Rural Urban Commuting Area Code of 4 through 10 as per the Office of Rural Health Policy.[23] Response frequencies were calculated and comparisons of categorical responses were performed using chi-square analysis or the Fisher exact test for low frequency responses. Significance was defined as $p < 0.05$ for a two-tailed test.

Responses to requests for comments and how to improve the project (See Table 1b, questions 5–8) were compiled. Qualitative analysis of the responses with theme and sub-theme creation, as

well as placement of individual comments, was performed independently by Drs. Jennissen and Denning. They reviewed and discussed the coding and then through an iterative process resolved all differences. The number of comments for each theme, each sub-theme, and the total were calculated. Representative comments are included in this report.

Results

Of the 1,244 agribusinesses that were delivered an ATV safety poster, 36% were farm supply stores, 23% were feed stores, and 41% were farm equipment dealers. See Table 2. Nearly three-quarters of the agribusinesses that received the poster were classified as being in a rural area. The characteristics of the businesses returning the postcards mailed with the survey (agribusiness type and rural/urban breakdown) were not significantly different from the agribusinesses receiving the posters, nor were the agribusinesses that consented to participate in the telephone survey relative to the overall population, $p \geq 0.21$ for all comparisons.

Postcard survey results

A total of 106 postcards sent with the posters were returned (8.5%). In addition, among those that returned the postcard, eight businesses (7.5%) reported they did not have walk-in customers. Excluding businesses with no walk-in customers, 97% of the agribusinesses that returned the postcard stated that they would display the ATV safety poster in their workplace. See Table 3. Almost half of farm equipment dealers stated they were placing the poster near the counter, while farm supply and feed store postcard respondents had higher proportions (58%) stating they would place the poster on a bulletin board near the entrance, or on/near the entrance door.

Overall, 95% stated that they believed the safety poster distribution project was a worthwhile project. When asked whether they thought the poster would make people think about ATV riding safety, about one-third said "yes" and nearly two-thirds chose "maybe." Less than 5% stated "no." With regard to whether they thought the poster would change ATV riding behavior, postcard feedback respondents were more guarded with only 6% saying "yes" and three-quarters stating "maybe." Nearly one-fifth felt the poster would not change riding behavior.

There were no significant differences in the distribution of agribusiness type, nor in the rural/urban location of the business, with regard to postcard respondents' willingness to display the poster, belief in the project being worthwhile, and whether they thought the poster would make people think about ATV safety or change riding behavior, $p \geq 0.1$ for all comparisons.

Telephone survey results

Just over one-third of the telephone survey participants recalled receiving the poster. See Table 4. Nearly three-quarters of those who recalled receiving the poster posted it. Of those agribusinesses with walk-in customers, an even higher percentage of

Table 2. Demographics of the agribusinesses that received the ATV safety poster (N = 1266), those that returned the postcard mailed with the poster (N = 106), and those of the participants in the telephone survey (N = 171).

	Poster delivered	Returned postcards		Participated in telephone survey	
	n (col %)	*n* (col %)	*P* value[a]	*n* (col %)[a]	*P* value[b]
Agribusiness type					
Supply stores	448 (36)	33 (31)	0.21	64 (37)	0.41
Feed stores	286 (23)	32 (30)		45 (26)	
Equipment dealers	510 (41)	41 (39)		62 (36)	
Location type					
Rural	896 (72)	76 (72)	1.0	124 (73)	1.0
Non-Rural	348 (28)	30 (28)		47 (27)	

[a]Chi square comparison of businesses that returned postcards vs. businesses that had posters delivered.
[b]Chi square comparison of businesses that participated in telephone survey vs. businesses that had posters delivered.

Table 3. Results from postcard surveys mailed to agribusinesses along with an ATV safety poster. $N = 106$ participants.

		Agribusiness type			Rural/urban	
	All	Supply store	Feed store	Equipment dealer	Rural	Urban
1. Will you display this poster in your business?[a]						
Yes	95 (97%)	30 (97%)	29 (97%)	36 (97%)	71 (99%)	24 (92%)
No	3 (3%)	1 (3%)	1 (3%)	1 (3%)	1 (1%)	2 (8%)
2. If yes, where will you display the poster?[a]						
Entrance door	21 (22%)	9 (30%)	8 (28%)	4 (11%)	17 (24%)	3 (13%)
Bulletin Board	24 (25%)	10 (33%)	7 (24%)	7 (19%)	15 (21%)	9 (39%)
On Wall	17 (18%)	4 (13%)	5 (17%)	8 (22%)	14 (20%)	8 (35%)
Near Counter	29 (31%)	5 (17%)	7 (24%)	17 (47%)	21 (30%)	3 (13%)
Other	4 (4%)	2 (7%)	2 (7%)	0 (0%)	3 (4%)	0 (0%)
3. Do you believe this is a worthwhile project?						
Yes	98 (95%)	30 (94%)	30 (97%)	38 (95%)	72 (97%)	26 (90%)
No	5 (5%)	2 (6%)	1 (3%)	2 (5%)	2 (3%)	3 (10%)
4. Do you think the poster will make people think about ATV riding safety?						
Yes	33 (32%)	10 (30%)	10 (31%)	13 (33%)	27 (35%	6 (21%)
No	4 (4%)	3 (9%)	1 (3%)	0 (0%)	3 (4%)	1 (4%)
Maybe	67 (64%)	20 (61%)	21 (66%)	26 (67%)	46 (61%)	21 (75%)
5. Do you think the poster will change ATV riding safety behavior?						
Yes	6 (6%)	1 (3%)	2 (6%)	3 (7.5%)	5 (7%)	1 (4%)
No	18 (17%)	7 (21%)	8 (25%)	3 (7.5%)	11 (14%)	7 (24%)
Maybe	81 (77%)	25 (76%)	22 (69%)	34 (83%)	60 (79%)	21 (72%)

[a]Questions 1 and 2 excluded businesses with no walk-in customers, $n = 8$.

Table 4. Results from telephone surveys of a randomized sampling of agribusinesses mailed an ATV safety poster. $N = 171$ survey participants.

		Agribusiness type			Rural/urban	
	All	Supply store	Feed store	Equipment dealer	Rural	Urban
1. Do you recall receiving in the mail an ATV Safety Poster?						
Yes	59 (35%)	20 (31%)	22 (49%)	17 (27%)	44 (33%)	15 (32%)
No	112 (65%)	44 (69%)	23 (51%)	45 (73%)	80 (67%)	32 (68%)
2. Was the ATV Safety poster ever posted in your business?						
Yes	43 (73%)	16 (80%)	17 (77%)	10 (59%)	34 (77%)	9 (60%)
No	16 (27%)	4 (20%)	5 (23%)	7 (41%)	10 (23%)	6 (40%)
Would you have displayed the poster if you had noticed receiving it?[a]						
Yes	80 (71%)	33 (75%)	13 (57%)	34 (76%)	55 (69%)	25 (80%)
No	32 (29%)	11 (25%)	10 (43%)	11 (24%)	25 (31%)	6 (20%)
4. If posted, where was it displayed?						
Entrance door	15 (35%)	5 (32%)	4 (24%)	6 (60%)	6 (18%)	3 (33%)
Bulletin board	12 (28%)	4 (25%)	4 (24%)	4 (40%)	12 (35%)	0 (0%)
On wall	2 (5%)	2 (13%)	0 (0%)	0 (0%)	5 (15%)	3 (33%)
Near counter	7 (16%)	3 (19%)	4 (24%)	0 (0%)	6 (18%)	1 (11%)
Break room	7 (16%)	2 (13%)	5 (29%)	0 (0%)	5 (15%)	2 (22%)
5. Is the poster still displayed?						
Yes	32 (74%)	12 (75%)	14 (82%)	6 (60%)	26 (76%)	6 (67%)
No	11 (26%)	4 (25%)	3 (18%)	4 (40%)	8 (24%)	3 (33%)

[a]Asked if answer to Question #1 was "No."

those who recalled getting the poster (81%) had displayed it. Overall, about three-quarters of posted posters were still being displayed at 1 month.

Of businesses with walk-in customers, 83% stated they would have displayed the poster had they received it. The perceived effectiveness of the project in reaching people about ATV safety had a mean of 2.74 on a 1–5 scale with 1 being very effective and 5 being not effective at all. As with the postcard surveys, there were no significant differences in the distribution of agribusiness type, or in the rural/urban location of the business, with regard to telephone respondents' willingness to display the poster.

Qualitative data analysis

The agribusiness owners/managers were also asked to provide comments that they heard from customers and employees, as well as to provide their own

comments about the project and how it might be improved. Of the 43 participants whose businesses had displayed the poster, six provided comments from customers and 11 shared employee comments. Of all participants, 89 commented on the project with nearly 90% providing positive comments regarding the project and the effort to improve ATV safety awareness. Sixty-nine provided responses with regard to how the project could be improved. The most frequent comments included (a) the need to have a broad reach and frequent, recurrent messaging, (b) to especially reach out to children, and (c) to better identify the most appropriate businesses with customer traffic for poster display. In addition, the study participants suggested other partners to assist in ATV safety promotion efforts and other venues and methods to potentially share ATV safety information.

Table 5 summarizes the organization of the compiled comments into 6 major themes and 19 subthemes, with a total of 236 individual comments. Visibility (Theme 1) included comments about the poster being noticed, being commented on, being discussed, or raising questions. Positive comments (Theme 2) were related to poster content or study design and were divided into comments by employees ("One said it was a good poster") and those by the survey respondent ("I think it's a good project"). Critical comments (Theme 3) were divided into those related to the poster design or the study approach ("I don't know that a poster would change behavior much") and those related to the business itself not being the best venue for poster display ("I have no store front to put the poster in").

Table 5. Themes and sub-themes identified from comments received.

Themes/sub-themes	#Comments
Theme 1. Visibility (*N* = 12, 5%)	
1a. Among employees	4
1b. Among customers/salespersons	8
Theme 2. Positive comments (*N* = 82, 35%)	
2a. By employees	5
2b. By respondents	77
Theme 3. Critical comments (*N* = 21, 9%)	
3a. Study approach not effective	9
3b. Not best venue	12
Theme 4. Topic relevance (N = 41, 17%)	
4a. Recognized dangers of ATVs	8
4b. Personal or community experiences with ATV crashes and injuries	11
4c. Personal efforts and community need to encourage ATV Safety	22
Theme 5. Suggestions for improving project (*N* = 33, 17%)	
5a. Improve chances of poster being displayed	8
5b. Improve distribution of posters to agribusinesses	8
5c. Additional venues to send posters	11
5d. Ways to improve posters	6
Theme 6. Additional suggestions for ATV safety awareness and injury prevention (*N* = 47, 20%)	
6a. Using other media/multimedia	7
6b. Additional partners and venues	12
6c. Safety training suggestions	4
6d. Safety legislation/regulations	5
6e. Direct targeting/mailing	7
6f. More and specific safety information	12
Total	236

For topic relevance (Theme 4), the three subthemes were recognized dangers of riding ATVs, personal or community experiences with ATV crashes and injuries, and personal efforts and community need to encourage ATV safety. Examples of each sub-theme were "I have seen kids do scary things like fly out of a ditch" (Theme 4a), "We have a cousin who died because he wasn't wearing a helmet. He died of head injuries" (Theme 4b), and "I have grandkids that ride on ATVs and I talk to them about safety" (Theme 4c).

From our question soliciting ideas for improvement, comments received included those for specific improvement in the poster or project (Theme 5) and additional suggestions for promoting ATV safety awareness and injury prevention (Theme 6). An example of a comment related to increasing poster display (Theme 5a) was "If I would have received a phone call (telling me a poster was being sent to us) I might have paid more attention. If it's not directly related to our business I don't really pay attention," and a comment for improving distribution (Theme 5b) was "A good mailing list is key." Comments related to additional venues (Theme 5c) and to improving the poster (Theme 5d) were "Give them (the posters) out to local country schools and see what response the schools have" and "Make the poster bolder and use big letters so it will catch your eye better," respectively.

For Theme 6, comments included those related to use of other media (Theme 6a, "Multimedia seems to be effective. Studies have shown that billboards and radio in combination get the word out well") and additional partners or venues (Theme 6b, "Ag teachers would be good to use"). Examples of other sub-theme related comments were "An ATV safety class closer to our area would be good" (Theme 6c), "Lobby to require

helmets for ATV use" (Theme 6d), "Send direct mailers to farmer's homes" (Theme 6e), and "You should use small business cards or flyers so people can take them home and look at them later. That may be effective" (Theme 6f).

Postcard vs. telephone survey results

Of businesses with walk-in customers, the proportion of postcard respondents who stated they would display the poster in their business (97%) was significantly higher than the actual percentage posted (81%) by businesses that had recalled receiving the safety poster in the telephone survey (odds ratio, OR 12.7; 95% Confidence Interval, CI 3.7–42.9, $p < 0.0001$). There were also differences between telephone survey respondents and postcard survey respondents with respect to where the posters were displayed. The former had higher proportions for on or near the entrance door (35% vs. 22%) and lower proportions for posting on the wall (5% vs. 18%). The comparison had an overall p value of 0.009.

Estimated costs

The project's overall cost to display an ATV safety poster in an agribusiness was calculated. Of all telephone survey respondents' businesses, 25% displayed the safety poster. In the first month, 43 businesses had displayed the poster for a total of 1,245 days, an average of 29 days per business. If one assumes a similar percentage of all businesses receiving the poster displayed it for a similar period of time as the telephone survey group, then a total of 311 businesses (25% of 1,244) would have displayed the safety poster for a total of 9,019 days. Given that the cost of the project was $1,500, each poster was displayed in the first month at a cost of 16.6 cents per day. However, since nearly three-quarters of businesses still had it posted at the time of the telephone follow-up 4–7 weeks after poster delivery, the final cost per day for displaying a poster was ultimately much less.

Discussion

An ATV safety culture in rural areas is largely missing. A focus group study by Aitken et al. found that ATV operators endorsed the need for increased awareness by the general public, particularly parents, about the potential dangers of ATVs.[3] Many of the agribusiness owners and managers in the study echoed this sentiment stating that it "was important to promote awareness" and that "we need to get people's attention" and "just keep getting the word out." Raising the community's awareness of safe riding practices will be essential for building a broader ATV safety culture.

There are no ATV operator training requirements for adults in any state and so most adults are untrained. Youth ATV operators also receive little or no training, and studies have found that only 15–26% of young riders reported having any safety education.[13–15] In addition, there are relatively few published reports on ATV safety and injury prevention programs. Most have been a smaller part of a broader effort such as a hunter safety education program[24] or farm safety day camps.[25–28] Reports on the effectiveness of school-based ATV safety education programs in increasing safety knowledge are also available.[14,29] There are no published studies on broader public ATV safety campaigns.

An upper Midwest agricultural health and safety forum concluded that the promotion of agricultural education to reduce illness and injuries would require the collaborative efforts of a diverse array of individuals and organizations, including agribusinesses.[30] Many groups, including the AgriSafe Network,[31] Community Partners for Healthy Farming Intervention Research,[32] the North American Agromedicine Consortium,[18] and the National Children's Center for Rural and Agricultural Health and Safety[33] to name a few, have recognized the value of agribusinesses as a partner in improving agricultural health and safety and have fostered their involvement in organizational activities. Agribusinesses at a regional and national level have been important financial supporters of agricultural safety and health efforts.[17,19,32] Although agribusinesses at the local level are involved with and support community farm health and safety initiatives, their efforts are not well documented in academic publications.

The effectiveness of health and safety campaigns can be understood via several theoretical foundations that involve marketing, communication, and

behavioral change.[34] Concepts important to the effective communication of messages include channel selection and message placement.[35] Channel selection involves determining the type of media to be used to convey one's message, especially considering how it can be most effectively and efficiently delivered to the target audience.

A review of articles published from 1990–2013 that reported the outcomes of health campaigns focused on physical activity, healthy eating, smoking cessation, or drinking behavior found that that 66% of them utilized posters as at least one of their media channels for message delivery.[36] Only television and print media were utilized more frequently. Three of the studies used posters as their only messaging channel.

There is evidence that campaigns that utilize a combination of media channels to deliver their message may be more effective than those that use only one channel. However, campaigns utilizing multiple channels also require more funding. Since our money was limited, we chose to distribute a safety poster by mail to agribusinesses in order to reach our target audience.

Nearly 90% of agricultural producers at Iowa county fairs reported utilizing local equipment/implement dealers, agribusiness supply stores, or grain elevators as a source to obtain safety and health information at least once a year.[37] Moreover, greater than half said they use them as a source more than once a month, and over three-quarters of these users reported mostly or completely trusting that information. In another study, farmers in focus groups indicated that they seek information from sources they most highly trust.[38]

One of the strongest indicators of a person's willingness to adopt a health behavior is the credibility of the source,[35] which is related to expertise and trust.[39] A source considered highly credible can create a more positive attitude toward the delivered message and generate greater behavioral compliance than sources with low credibility, particularly if the message advocated is perceived as valid.[40] As people are more inclined to process in-group messages,[41] safety information delivered by people with farming backgrounds or through trusted networks should enhance message uptake by farmers.

The owners and managers of local agribusinesses are trusted community members to farmers, and safety messages displayed in their establishments may be more influential than placement in many other venues. In addition, farmers are likely to regularly frequent these businesses, increasing their chances of repeat exposure to the messaging. It has been shown that repeated exposure can increase the likelihood of message recall and related action in farmers.[42]

In our study, we sent postcard surveys with the safety posters to see how many agribusinesses would respond. Not surprisingly, the response rate was low (8.5%), but of those who returned the postcard there was a very high percentage reporting that they would display the poster (97% that had walk-in customers). Such feedback methods are likely to result in a biased sampling. Consistent with this hypothesis, of the randomized businesses in the telephone survey group that recalled receiving the poster, a significantly lower percentage with walk-in customers had displayed the poster (81%).

Overall, the owners and managers of agribusinesses appeared interested in promoting ATV safety. Many of the telephone survey participants stated they thought the project was "a good idea," "worthwhile," "a good thing to do," and "time well spent." Some of the comments they shared demonstrated their recognition of a general lack of ATV safety awareness in their communities, and that ATV-related injuries are a significant problem. These statements by owners and managers included:

- A lot of people don't know about ATV safety.
- People need to be more informed on how ATVs operate.
- Your project makes a lot of sense. Those things are dangerous.
- The younger people need to pay attention to this stuff because they never think it will happen to them until they wreck and then it's too late.

Numerous agribusiness owners and managers shared personal experiences and knowledge of recent ATV-related deaths and injuries in their communities. For example:

- The timing was good. We just had a serious ATV crash in our town.

- We had a friend pinned underneath an ATV who could barely reach his cell phone to call for help.
- Not too long ago a child operating a vehicle ran over and killed another child in our area.
- A friend of ours had a daughter get in an accident shortly after we received the poster and it made me think about the poster.

We hoped that the project might make the customers of agribusinesses think about ATV safety and consider how they might change their riding behaviors on their farms and homes. Survey participants reinforced that this was indeed happening and that their customers were noticing the poster. Some reported that parents were showing their kids the poster and talking about the stated safety messages. However, one manager inferred that not everyone was accepting of the project and its goals, but he himself felt it was important. He stated that some customers asked him "what was going on here" related to the poster, and he simply told them "it was a safety bulletin."

One thing we did not anticipate was that the project would affect the employees, owners, and managers of the agribusinesses themselves. Participants in the telephone survey discussed how the poster generated discussion among their employees and salesmen who came to their businesses. It seemed to have encouraged them to talk to their own families about ATV safety. A number of owners and managers even put the poster up in their employee break rooms instead of other areas of their business. Participants provided other comments, questions, and actions by their employees including:

- Several employees said the poster was a good idea because they use ATVs and so do their kids.
- They agreed with your cause.
- They passed the poster around and talked about the way they use ATVs.
- My employees asked 'Where did it come from? What is it about?' I told them, 'Nice people do these kinds of things.'

Comments were also solicited as to ways we could improve the project. The majority of agribusiness owners and managers relayed the importance of improving ATV safety in their rural communities and were very encouraging to keep up the effort. Some felt the project might be improved by having more literature available to give out, and a manager suggested a safety information tear sheet that could accompany the poster. One business owner suggested being provided an ATV safety card or pamphlet that he could send out to their customers with their bills.

Many survey participants felt that a good mailing list for a project like ours was key. Despite our efforts to limit this problem, the poster was sent to a number of agribusinesses that did not have any or many walk-in customers. Although these subjects were supportive of the effort and thought we were targeting the right population, they felt that their business was not the most appropriate venue and that the poster could have been sent somewhere better suited such as schools, even at swimming pools. One person recommended utilizing the state agribusiness association to improve poster distribution.

Some survey participants said sending a poster in the mail was not enough to get their attention. A few owners and managers admitted that they probably threw the poster away without opening it. Some felt the most effective way, instead of mailing the poster, would be to "Go to the store and ask permission to hang up the poster." Others recommended pushing them a little to "make certain we put the poster up" and another stated that a follow-up phone call before or after the poster was sent might be helpful.

The owners and managers provided a number of other suggestions regarding how one might approach increasing ATV safety awareness and practice. A number of them recommended other partners to reach the target population including 4-H clubs, FFA clubs, motorsport dealers, and insurance companies. They suggested being present at day safety camps, county and state fairs, and schools to provide education and live demonstrations. Many discussed the need to utilize multimedia including radio, billboards, agriculture newsletters, television, safety videos, and the internet. Some felt reaching farmers and ATV riders directly including mailing safety information to their homes may be more effective. As one business owner stated, "You need to establish direct contact with 4-wheeler owners, rather than just sticking a poster on a wall and expecting people

to look at it." Still, our study demonstrated that many agribusinesses were willing to display an ATV safety poster delivered to them by mail and that the cost per day of displaying each poster was very reasonable. Agribusinesses have great potential in being important influential agents of change and in partnering with other organizations to affect rural and farm safety.

Limitations

Because our telephone survey subjects represented ~14% of the agribusinesses that were mailed the survey, we cannot rule out the possibility of bias in the sample. However, the businesses in the telephone study were randomly selected and their demographics closely matched the whole population. Thus, it seems likely that the study group was a representative sample. As with all surveys, there is the potential for both recall and social desirability biases. The telephone surveys were administered no more than 7 weeks after businesses would have received the poster, so recall bias seems unlikely. Our study addressed basic questions about the effectiveness of mailing posters and the willingness of businesses noticing the posters to display them. Some comments suggested the posters were indeed being seen by customers and others, but our study was not designed to measure reach or impact. Additional studies would be needed to address these questions.

Conclusions

Agribusinesses are aware of injuries and deaths related to ATVs and seem to be interested in promoting ATV safety. Overall, a high percentage of agribusinesses in the study that were aware of receiving the project's safety poster displayed it. Although a significant percentage did not recall having received the poster in the mail, the vast majority of such businesses stated they would have displayed the poster as well. Once displayed in a business, safety posters may remain posted for prolonged periods of time as demonstrated by the results of our follow-up phone calls. Unfortunately, attracting the attention of agribusinesses and recruiting their participation through a mail-only approach appears to be challenging. Personalized mailings and/or follow-up phone calls may have the potential to increase participation. Additional safety materials to be handed out or displayed may also be beneficial. Despite the limitations, however, mass mailing of injury prevention materials to be displayed in the retail setting could be a low-cost method for raising safety awareness.

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Employers' Perspective on Childcare Services for Hired Farm Workers

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ABSTRACT

The goal of this project was to protect children while parents work in agriculture by improving off-farm services for children of migrant and seasonal farm workers. Large agricultural enterprises have policies forbidding children in the worksite. At the same time, their employees, who are trying to generate income, seek as many work hours as possible but often lack viable options for childcare services. As employers strive to increase their labor pool, and workers seek off-farm childcare, there is mutual interest in improving access to childcare services in agricultural regions dependent on large numbers of full-time and seasonal workers. This report describes the employers' perspectives on childcare needs of hired farm workers' families and their barriers and motivators to facilitating off-farm childcare services. Using descriptive survey research methodology, data were collected from a convenience sample of 102 agribusiness owners and Human Resource directors attending an agricultural conference regarding labor laws or personnel management. Results revealed significant differences for those companies employing more than 25 workers compared to their counterparts. Primary motivators for offering childcare as an employment benefit were improved employee morale, enhanced company reputation, and a more stable workforce. A major barrier was that half of large-scale enterprises lack guidance on how to provide childcare options for their workers. Survey results are being used to facilitate collaboration among employers, farm workers, and childcare providers to offer a safe, nurturing environment for children while their parents work in agriculture.

KEYWORDS

Agriculture; child care; employers; farm workers; socio-ecological model

Introduction

For most large-scale agricultural operations, children younger than 18 years are not permitted in the worksite. When the mother and father of young children both want income-generating jobs, the task of finding childcare services can be daunting. Similar to working parents in urban and rural non-agricultural settings, the goal is to find high quality, affordable, and available childcare services. However, the unique challenges faced in agriculture are that working parents may be hired for seasonal work and/or for work hours that extend beyond the days and times that childcare programs are open. Thus, hired farm workers, especially those employed for seasonal jobs with marginal incomes, face extra challenges when there are limited childcare options.

At the same time that farm workers struggle to find childcare services, agribusiness owners are striving to have a full capacity labor pool—employees who have the attention and energy to work productively in time-sensitive situations such as planting or harvesting. A shortage of seasonal and full-time workers in agriculture has a profound effect on the profitability and viability of an agricultural operation, and employers and their Human Resource (HR) directors search for incentives to recruit and retain valuable employees. Thus, available childcare services can be a "win-win" proposition for agricultural employers and their workers.

The socio-ecological model (SEM) depicts how multiple spheres of influence can penetrate down to the level of affecting an individual's behaviors.[1] When the SEM is modified to the agricultural setting, it is clear that employers have the potential to strongly influence the culture of safety for hired workers and their families.[2] In addition to establishing company safety protocols and requiring workers to comply with safety guidelines, employers can also promote and facilitate the general well-being of their workforce and their families

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through holistic programs and financial support of community services. Agricultural employers who promote, facilitate, and encourage workers to utilize high quality off-farm childcare services help promote the well-being and livelihood of children. Additionally, working parents whose children are utilizing high quality childcare services have increased peace of mind and can work more productively.

Background

Over the past several years, information regarding farm parents' and hired farm workers' perspectives on quality childcare has become available. A 2012 report on childcare needs of farm families described the on- and off-farm work demands of farming parents that compromise their ability to supervise children.[3] Features of currently used rural childcare services included reliance on relatives, access to preschool or Head Start programs, and a dependence on mixed options (i.e., formal programs and relatives in-home) because of the inconsistent work hours in agriculture and distance and time to formal settings. Desired characteristics of ideal off-farm childcare programs included: accessibility in terms of time and distance to nearest location; availability in terms of eligibility of child/children, opening slots, and hours of service; and affordability, especially for low-income families. Recommendations for addressing the shortage of rural childcare options were presented, including the engagement of agribusiness leaders to collaboratively address the critical need for childcare services with community leaders and local social service agencies.[3]

Migrant and seasonal farm worker families have challenges associated with language differences, limited financial resources, being migrant and moving in order to work, as well as barriers to education, transportation, healthcare services, housing, and childcare.[4,5] Farm workers, especially those involved in seasonal work, typically try to work as many hours as possible, but often are held back from work due to lack of childcare services. This is especially problematic when both the mother and father desire gainful employment. Moreover, according to the most recent National Agricultural Worker Survey (NAWS) report, there are an increasing number of women employed in agriculture, potentially increasing the need for childcare services.[6]

A project in Washington State, funded by the Agricultural Safety and Health Council of America (ASHCA), provided preliminary data for our project.[7] To better understand the challenge of safeguarding children while parents work in agriculture, focus groups were conducted at the agricultural worksite in break rooms or workshops with 27 farm workers. Farm worker women revealed that children are occasionally brought to the worksite with or without the employers' knowledge, because they had no alternative other than to miss work.[8] Farm worker women described their interest in generating income, and many indicated they would prefer to work extended hours in agriculture (vs. caring for children) if they could be assured their young children were in a safe environment and, ideally, with educational and recreational experiences. Most large agricultural enterprises have policies forbidding children in the worksite. Employers understand the risks and potential liability associated with children in a hazardous worksite. Given farm labor shortages in some areas, employers want to pursue options that increase the labor pool and reduce parents' stress regarding availability of services for their children.[9] The same Washington state project that conducted focus groups with farm worker women also gathered information from 44 agricultural employers regarding their employee's needs for childcare.[7] Nearly half of respondents reported their employees frequently needed care options for children younger than 6 years, and most (84%) indicated children are never or rarely brought to the worksite. The majority responded positively about trying to increase access to childcare and youth services for their workers, noting they need compatible hours and increased funding support.

Methods

For this descriptive cross-sectional survey research study, we pilot tested and refined a paper-based data collection tool that was distributed to a convenience sample of attendees at agricultural conferences attended by owners or representatives of

agricultural companies seeking information on labor regulations and/or personnel management. The research plan was reviewed and approved by the Marshfield Clinic Research Foundation's Institutional Research Board (IRB).

Instrument

The data collection objectives were to increase our knowledge about employers' current practices regarding support of childcare services for hired farm workers' families; to gain insights into barriers and motivators for offering childcare service as an employee benefit; and to understand any relationships between the survey respondents' characteristics and variables of interest. The theoretical basis for questions was partially based upon the Behavioral Reasoning Theory,[10] which the principal investigator had applied in a previous study that benchmarked employers' hiring and safety practices for adolescent farm workers.[11] Variables and terminology were initially tested in a questionnaire given to 27 employers attending a February 2015 annual meeting of the National Council of Agricultural Employers (NCAE) when the topic of model childcare services for farm workers was first presented.[12] Interviews with farm worker parents and childcare providers served as another source for variables and terminology.[13]

A 50-item survey instrument was drafted, pilot tested and refined. Five-point Likert-type scales (never to often; not important to extremely important; and strongly disagree to strongly agree) were used to measure variation in practices. Discrete response options or continuous variables (yes/no or numbers) were used to depict respondents' personal characteristics and their agricultural business. The survey instrument was provided as a single sheet, two-sided paper form.

Data collection

Two agricultural employer events served as sites for data collection. The study team did not attend these events, but arranged with the organizers in advance via telephone and written instructions to follow specific steps for distribution, collection, and final return of survey forms. Event organizers were told they would receive an executive summary of findings that they could share with their respective constituents.

In December 2015, the National Council of Agricultural Employers (NCAE) convened a Labor Forum in Las Vegas, NV. This 2-day conference was an opportunity for labor-intensive agricultural business representatives to learn the legal and practical aspects of hiring migrant and seasonal workers. Among the 210 attendees were lawyers, company owners, contract labor organizers, and HR managers (or comparable title). At the beginning of the Labor Forum, the event leader read from the prepared script, making an announcement about this project and requested that "any persons responsible for company/employee benefits or company policies regarding children" pick up a blank survey form at the registration desk. It was stressed that "no personally identifiable information would be collected." Completed forms could be returned at the same location and survey respondents would be given a small gift (a chocolate candy "cow pie" bar) as a token of appreciation. At several points during the forum, this announcement was repeated.

The second site for data collection was the January 2016 Annual Conference of Agricultural Personnel Management Association in Monterey, CA. This 2-day meeting is typically attended by 175 California-based agricultural company HR directors, lawyers, marketing consultants, and risk managers. The same survey instrument and solicitation process for securing completed survey forms were used. Registration desk personnel facilitated distribution of surveys and provided the gratuity candy bar upon return of the form.

At both data collection sites, completed forms were placed into a large envelope out of sight of event attendees. At the closing of the event, the envelope was sealed and immediately placed in a prestamped, express-return envelope to the study team. No problems were associated with the process. Extra blank forms were destroyed, and leftover candy was given to the event staff in gratitude for their assistance.

Data entry/analyses

Data from written survey forms were coded and entered by trained staff using a systematic process to consistently resolve aberrant responses, missing

data, or illegible writing. Classification of jobs written as "other" was determined through consensus, as were decisions about clustering categories of responses for interpretation of findings. Data quality systems were implemented to ensure that data were collected, entered, and analyzed accurately. For this component of the project, quantitative data were analyzed via SAS (Cary, NC, USA). Descriptive statistics were obtained and reported. Categorical data were analyzed using Chi-square or Fisher's exact test, and *P*-values were derived from the abovementioned statistical tests. A *P*-value of <0.05 was used to claim that there exists a statistically significant difference.

Initially, data from 71 participants (34% of attendees) at the Las Vegas event were reviewed, followed by data from the 31 participants (18% of attendees) of the Monterey event. Data were then analyzed to detect significant differences between the two groups' demographics and study variables. Next, all data were merged and reviewed to assess collective responses, looking for any major outliers. Following this, merged data were analyzed to account for statistically significant differences based upon gender, respondent role (e.g., Owner, HR director), number of children/grandchildren, and number of employees. Basic descriptive statistics were obtained and reported, and *P*-values were derived from Chi-square or Fisher's Exact test for categorical data and Wilcoxon Rank Sum test for continuous variables.

Results

A total of 102 (71 + 31) usable surveys comprised the study sample from participants attending either of the two agricultural conferences. Of these, 59% were male. The average length of time working in agribusiness was 19.4 years, with an average of 15 years in his/her current company. Age of respondent was not asked, but a proxy was the number of children (mean = 2.5 children) and the number of grandchildren (mean = 2). The primary crops/products of respondents were grains, livestock, berries/grapes, and tree fruit. A question to address the company size in terms of workforce was "During peak production season, about how many employees do you typically have?", and response options were ≤25, 26–50, 51–100, 101–200, and 201 or more. Nearly half (48%) reported employing 201 or more workers, while 26.5% had 25 or fewer workers, and 25.4% had from 26 to 200 workers during peak season.

Respondents were asked about the type of childcare arrangement their employees currently use for children 0–6 years; to the best of their knowledge, they reported about 72% "sometimes" or "often" used a formal childcare center. About 80% responded that adult family members provided childcare, 89% reported a brother/sister in the home provided care, and 41% reported employees occasionally accessed a day camp or local park program. Only 9.4% had a company-owned childcare program for employees.

Table 1 depicts the sample demographics based upon the conference at which the survey was administered. The Las Vegas conference, for which the primary topic was federal labor laws with a focus on immigrant workers, had a majority of male respondents who were company owners/employers. Respondents from the Monterey, California conference, which addressed a variety of hiring and personnel management issues, were 83% female, and only 7% were owners/employers. Most of these participants reported being HR directors, risk managers, or filled in job titles such as Executive Assistant.

When combined data from both events were analyzed to contrast responses based on demographic variables (gender, role, number of chil-

Table 1. Subjects by location.

	Las Vegas	Monterey	
Total	71	31	*P*-value
Gender [# (%)][a]			
Male	36 (51.4)	5 (16.7)	.0015
Female	34 (48.6)	25 (83.3)	
Role [# (%)]			<.0001
Employer	34 (50.8)	2 (6.9)	
HR director	15 (22.4)	13 (44.8)	
Other	18 (26.9)	14 (48.3)	
Produce [# (%) Yes][b]			
Grains	45 (63.4)	30 (96.8)	.0002
Tree fruits/nuts	64 (90.1)	25 (80.7)	.2070
Berries/grapes	58 (81.7)	14 (45.2)	.0003
Beef/dairy/swine	49 (69.0)	30 (96.8)	.0016
Nursery/greenhouse	65 (91.6)	28 (90.3)	1.000

HR, Human Resource.
[a]Nonresponses were eliminated from the number/percentage calculation.
[b]More than one response permitted.

dren/grandchildren, company size), only a few statistically significant differences were detected. The greatest contrast was detected based upon company size, that is, the number of hired workers employed. The project team agreed to focus additional analyses on responses associated with those having >25 hired workers, since the project's overall goal was to facilitate off-farm childcare services in agricultural regions with the high populations of hired farm workers. Thus, further analyses were based upon company size, as measured by small agricultural company (≤25 employees) versus a large agricultural company (>25 employees).

There were 6 of the 102 survey respondents who did not answer the question regarding number of employees; thus, the number of usable surveys for analyses based on company size was 26 individuals with ≤25 employees and 70 individuals with >25 employees. Table 2 reflects their demographic characteristics. Respondents from large companies were slightly more likely to be female, far more likely to be an HR director or nonowner, and tended to have fewer years working in agriculture, fewer years at his/her current company, and fewer children and grandchildren. This suggested that participants from large companies may be younger in age than those from smaller companies.

Respondents were asked about employees' childcare needs and his/her company practices regarding childcare as an employee benefit. For large companies, 92% believed employees need care for children age 0–6 years, and 90% reported their employees need before/after school care for 7–14-year-olds (Table 3).

Table 2. Subjects by number of employees.

	≤25 Employees	>25 Employees	*P*-value
Total			
Gender [# (%)][a]			
Male	14 (53.9)	26 (37.1)	.1661
Female	12 (46.1)	44 (62.9)	
Role [# (%)]			<.0001
Employer	19 (79.2)	18 (26.5)	
HR director[b]	3 (12.5)	36 (52.9)	
Other	2 (8.3)	14 (20.6)	
Years working (median)	25	15	.0757
Years w/this company (med.)	20	8	.0036
Median # children	3	2	.0377
Median # grandchildren	0	0	.0308

HR, Human Resource
[a]Nonresponses were eliminated from the number/percentage calculation.
[b]Includes HR managers or comparable title.

Table 3. Childcare needs by company size.

	≤25 Employees	>25 Employees	*P*-value
[# (%) responding sometimes/often]			
Employees need care for 0–6-year-olds	11 (50)	60 (92.3)	<.0001
Employees need before/after school care for 7–14-year-olds	8 (36.4)	54 (90.0)	<.0001
Despite rules, employees bring 0–14-year-olds to worksite	9 (47.3)	12 (18.5)	.0087
Company assists locating services	4 (22.3)	20 (32.8)	.6407
Company gives financial support	4 (22.3)	10 (15.4)	.3409

Both these concerns were statistically different than smaller companies ($p \leq .0001$). With smaller companies, about 47% of employees sometimes bring children into the worksite, despite company rules forbidding their presence; contrasted to only 18.5% occurrence on large enterprises ($p = .0087$). There was no statistically significant difference between small or large companies regarding their current practice to assist employees with locating services (22% vs. 33%) or providing financial support for childcare services (22% vs. 15%).

Of keen interest to the project team were barriers and motivators to providing childcare services as an employee benefit. Table 4 data reveal that about half of respondents from large companies indicated they need guidance on how to facilitate and implement childcare services for employees, and they are in a position of authority to implement such services. When asked about company priorities, only 5.7% of large companies indicated that this was a low priority, in contrast to small companies, where 27.3% viewed this as a low priority ($p = .0059$). Customers of small companies (26%) were less likely to care about employee benefits than large companies, where it was reported by only 11.8% respondents that customers do not care about workers' benefits.

Table 4. Barriers to providing childcare by company size.

	≤25 Employees	>25 Employees	*P*-value
[# (%) responding agree/strongly agree]			
Is NOT a high priority	6 (27.3)	4 (5.7)	.0059
Have position of authority to implement	7 (30.5)	38 (55.0)	.5635
Company needs guidance	7 (30.5)	35 (50)	.0011
Customers do not care about employees' benefits	6 (26.0)	8 (11.8)	.1399

Based on preliminary studies, motivators to providing childcare services were categorized into eight factors with response options on a 5-point scale of not important, slightly important, important, very important, and extremely important. Of these, there was a statistically significant difference between small and large companies for seven of the eight factors (Table 5). For depicting the details in Table 5, responses of important, very, and extremely important were clustered. The primary motivators for large companies to facilitate and/or provide childcare services were a "more stable workforce" (90%) and "improved employee morale" (90%). This was followed by "enhanced company reputation (88%). Large companies recognize that childcare services would allow employees to work more hours (78%) and facilitate employment of more women (73%). Childcare services could be used as a recruiting tool (70%), and large companies (77%) indicated that this would reduce their concern about childhood injuries. Large companies were slightly more likely (66%) to view "decreased jeopardy regarding child labor issues" (e.g., lower risk of penalties for violating laws) as a motivator than small companies (41%).

Factors that would motivate large agricultural companies to offer childcare services as an employee benefit are further delineated in Figure 1. Specific responses on a 5-point scale (not important, slightly important, important, very important, and extremely important) are depicted by percentage of total responses. When considering what is an "extremely important" motivator, the factors of improved employee morale and enhanced company reputation are rated the most highly.

Table 5. Motivators to providing childcare by company size.

	≤25 Employees	>25 Employees	*P*-value
[5 pt. scale; # (%) responding extremely, very, important]			
Improve employee morale	12 (52.1)	62 (89.8)	.0006
Enhance company reputation	9 (39.1)	61 (88.4)	.0001
More stable workforce	11 (47.0)	61 (89.8)	.0002
Recruiting potential	7 (30.5)	49 (69.9)	<.0001
More female employees	6 (26.1)	52 (73.3)	<.0001
Able to work more hours	9 (42.9)	54 (78.3)	.0038
Reduced concern of child injuries	10 (45.5)	49 (76.6)	.0187
Decreased jeopardy—child labor	9 (40.9)	41 (66.2)	.0756

Discussion

The success of an agricultural business, especially a large operation with labor-intensive production activities, such as harvesting ripe fruits and vegetables, is absolutely dependent on a stable and capable workforce. Pursuing opportunities to secure a stable work force is an important motivator for employers particularly in light of increasing challenges associated with U.S. immigration policy and the political climate surrounding immigration reform. Thus, it is not surprising that agricultural employers view childcare benefits for employees as a potential strategy for recruitment and retention of workers.

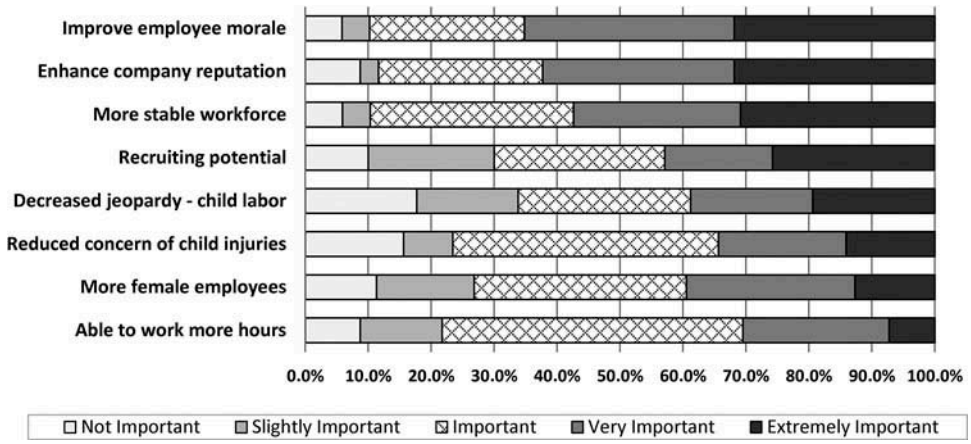

Figure 1. Large-scale employers' motivating factors for childcare services.

The current labor shortage in agriculture puts farm workers in a position of choosing an employer based on working conditions, salary, and benefits. This is especially the case for working parents who aim to "settle in" to a location for extended periods. Agricultural workers, especially those doing seasonal activities, are often interested in generating as much income as possible, but they may be hampered in accepting employment due to parenting responsibilities, which take precedence over work. Lack of childcare options increases the likelihood of employees missing work altogether, being tardy, or being distracted while at work. This translates back to three of the employers' top five motivating factors for facilitating childcare—"more stable workforce," "more female workers," and "able to work more hours."

Agricultural companies are sometimes viewed in a negative light by worker advocates and/or small-scale companies. Their priorities may be considered profits and competitive edge over their smaller counterparts. It was surprising to learn that the most highly rated motivating factor by the large company respondents was "improved employee morale," which is more often associated with smaller operations, especially those with family members engaged in leadership.

An interesting finding was that large-scale employers were more likely than small-scale employers to list "reduced concern of child injuries." This concern would seem more aligned with smaller enterprises that were more likely to report children coming into the worksite. It is possible that the preponderance of HR directors representing large-scale farms was very attuned to risk management and liability, or that because of their younger age, they were more concerned about the safety of children.

Data from this study describe a strong interest and willingness of large-scale agricultural employers to facilitate off-farm childcare options for their employees, with more than half expressing interest. Given that they appreciate the value of childcare services, this clearly indicates the need for someone or some organization to address this need.

Circling back to the SEM for influencing individual behaviors, this study revealed that large-scale agricultural employers are willing to adopt company practices with employee benefits that could trickle down to the level of protecting children from adverse exposures associated with agricultural environments. This relatively high level of influence could be extended even further if federal and/or state policies (highest sphere of SEM) provided financial support and guidance for off-farm childcare services.

Limitations

This study was limited in scope as a component of a larger initiative to facilitate off-farm childcare services for children of migrant and seasonal farm workers. A convenience sample was used of respondents interested in the topic; thus, results may be skewed to a best situation, and findings. The study participants, representing agricultural businesses (large farms, ranches, and vineyards), were drawn from events away from their worksite, which were not associated with the topic of this study. Data were derived from self-reports of respondents who were not in a position to confirm accuracy of certain responses (e.g., type of childcare currently used) with their employees. Further, the completion of survey forms was conducted in various locations within the conference area, likely with distractions, leading to incomplete forms and hurried responses. The primary goal was to understand pertinent perspectives of employers, and only 70 usable surveys were available to depict barriers and motivators to childcare services of large agricultural companies. Furthermore, no statistical power analyses were preplanned.

This study is the first known report on this topic. Although small in scale, the findings shed preliminary light on an important issue. For purposes of our overall project, only 50% of respondents indicated they were in a position of authority to implement programs, but by participating in this study, they became aware of business advantages that could be transmitted to company leaders. An option "for more information" on this topic was provided as a sign up sheet at the conference registration table so project staff could follow-up with guidance if so requested.

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Health and Safety Adoption from Use of a Risk Assessment Document on Irish Farms

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ABSTRACT

Objectives: This article describes levels of implementation of occupational health and safety (OHS) controls on a sample of Irish farms following completion of a risk assessment document (RAD) made available as part of a statutory code of practice (COP) for the agriculture sector. The article describes the legislation mandating the COP and the operation of a prevention initiative (PI) among key stakeholders to develop and promote farmer use of the COP and RAD. Methods: RADs were collected for farmers (N = 475) and the number and type of OHS controls listed for action were tabulated. A farm audit of OHS standards and of implementation of controls listed for action in the RAD was undertaken among a randomly selected sample of farms (N = 94) where the RAD was completed. Results: The study data indicates that farmers used the RAD to a limited extent, and that their focus in its use was on identifying physical rather than organizational controls. An association was found between farmers who actively implemented controls and positive OHS standards. Farm OHS standards were also associated with farmer attitude to OHS, farm enterprise, farmer age category, and work time needed to operate the farm. Conclusions: Overall, the study data suggests that standards of farm management are a crucial determinant of OHS standards. The study data also indicates that having knowledge of required OHS controls does not ensure implementation. Development of social learning in groups is considered as a significant means of increasing OHS farm adoption.

KEYWORDS

Adoption; management; OHS; risk assessment

Introduction

Internationally, the agriculture sector has an inferior safety record compared to other work sectors,[1] while research and knowledge on approaches to assist farmers to effectively manage occupational health and safety (OHS) through education and training and extension approaches is limited.[2] Devising, implementing, and evaluating such approaches have been the objective of a multi-agency initiative in Ireland based on recently introduced safety, health and welfare at work (SHWW) legislation.[3] This article reports on farmers' adoption of OHS standards and practices based on this initiative.

Regulatory theory indicates that public interest is the major justification for regulation.[4] In Ireland, a Commission of Inquiry on Safety Health and Welfare at Work recommended that "all at work, including farmers, be included under OHS legislation."[5] The Commission based its recommendation on the opinion that improving the OHS of the agriculture sector is in the interest of both individual farmers and the public. The Commission's recommendations were accepted by the Irish Government, which led to the enactment of the 1989[6] and subsequently the 2005 SHWW Acts. Thus, all workplaces in Ireland including farms are subject to SHWW legislation. This article describes an on-going legislative initiative that commenced following the 2005 Act to assist Irish farmers to achieve OHS legal compliance by completing a Risk Assessment Document (RAD) associated with a statutory Code of Practice.

It has been proposed that for successful regulation, programming should establish a synergy between persuasion and punishment.[4] They elaborated on regulatory strategies by outlining a pyramidal approach, which from the base consecutively has the following layers: self-regulation, enforced self-regulation, and command regulation with both discretionary and mandatory punishment. These authors consider that

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programming for successful regulation should be based broadly on the allocation of resources in proportion to space allocated for each strategy in the regulatory pyramid. This broadly is the approach of 'Robens-style' OHS legislation enacted in numerous countries.[7] This legislative approach involves implementation of systematic management of OHS at work including allocation of duties to all parties, consultation related to OHS, and implementation of risk assessment, hazard control and regular auditing. Thus, this approach to legislation moved from adopting prescriptive standards to systematic standards which are devised by each enterprise.

A comprehensive review of OHS regulation in the agriculture sector has been undertaken in Australia with a view to determining the optimal policy mix to gain OHS improvement in the sector.[8] This author considered that for success, OHS information must be disseminated to farmers by trusted sources in a face-to-face fashion. The OHS information must be sector-specific, user-friendly, emphasize practical solutions and its delivery must be effectively coordinated. He advocated developing and using Codes of Practice as he considered that small enterprises require much more specific guidance on OHS requirements than larger enterprises where more formal OHS management structures exist. Such codes can provide an effective way to provide practical guidance on how to achieve practical OHS compliance.

Worldwide, individual farms are both dispersed and operate in discrete units throughout the countryside and use a wide range of infrastructure, machinery and equipment, livestock, and products such as pesticides, all of which present hazards.[9] The nature of farming causes considerable challenges in applying SHWW legislation and mounting OHS advisory campaigns. In Ireland in 2006, there were 132,700 farms with average farm size of 31.8 Ha[10] and average family farm income of €16,680 (~$19,000 USD) compared to an average industrial wage of €29,110 (~$33,000 USD).[11] Data from the Irish National Farm Survey for year 2006 indicated that the percentage of farms in each of the principal farm enterprise categories were: specialist dairying (15%), dairying and other (8%); cattle rearing (24%); cattle non rearing (28%), mainly sheep (18%), and tillage (7%).[11] Estimates for the year 2006 indicate that family members supplied 95% of farm work-time, of which the farm holder supplied 66%, while the remaining 5% was supplied by nonfamily workers.[11] Thus, it is evident that Ireland farming is highly variable by enterprise, is small scale, and with low income where labor is mainly supplied by family members.

The background to the Irish Prevention Initiative is now described. Since 1989, all farms in common with all workplaces have been subject to SHWW legislation.[6] The legislative approach imposed the duty on farmers to complete a document described as a "Safety Statement," which required farmers to identify farm workplace hazards, assess risk, specify controls, and confirm their implementation. Following the enactment of this law, document formats were devised to assist farmers to prepare a Safety Statement; however, these required considerable time to complete in a written format, and studies showed limited uptake by farmers nationally.[12,13] In 2005, new SHWW legislation[3] was enacted that permits farms employing three or fewer employees (estimated to encompass circa 95% of farms nationally[11]) to meet the requirement to prepare a Safety Statement by instead completing and implementing an RAD prepared in conjunction with a statutory Code of Practice (COP). Statutory responsibility in Ireland for providing advice and guidance and enforcing statutory SHWW provisions rest with the Health and Safety Authority (HSA). For the agriculture sector, the HSA is advised on implementing the legislative provisions by a statutory advisory committee to its board referred to as the Farm Safety Partnership (FSP), which is representative of both state and farmer organizations with a role in farm OHS. In 2006, the HSA commenced a Prevention Initiative (PI) with Teagasc, the state Agriculture and Food Development Authority responsible for providing research, training, and advisory services to the agriculture and food sectors in Ireland, with the key role of devising the new RAD and COP approach, assisting farmers with its implementation and evaluating the utility of the new legislative approach in gaining OHS adoption among farmers nationally. During 2006 and 2007, the pilot phase of PI was implemented in consultation with the

FSP, which included the following components: development of pilot RAD for evaluation; training of Teagasc staff to deliver RAD training; provision of RAD 3.5 hour training to circa 2,500 farmers in 5 counties and a more extensive 12.5 hour course in 2 counties with circa 100 participants; circulation of RAD to farmers for completion in one county without provision of training; conduct of farm visits (N = 94) to access on-farm implementation of SHWW controls by farmers who completed the RAD and to assess approaches to the implementation of occupational health and safety (OHS) measures by farmers. Articles outlining farmers' and Teagasc advisers' (extension agents) opinions of utility of the RAD and associated 3.5 hour training in assisting farmers to manage farm OHS have previously been published.[14,15] This article reports on the findings related to implementation of controls by farmers following completion of the RAD in association with their overall approaches to farm OHS management. A copy of the RAD for 2016 that was adopted with minor modifications following the pilot phase of the PI is available on the HSA website.[16]

The pilot RAD principally comprised hazard identification sheets for the major work hazard categories (as listed in Table 1) encountered in Irish agriculture. Each sheet was accompanied by an information page giving short textual information associated with the hazard, pictures showing controls, and a pie-chart giving data on accident causes for the hazard based on a 10-year review of farm fatal accidents and causes of ill health. Each sheet was laid out in matrix format with key questions related to hazard control. Columns were provided for farmers to include the particulars of their farm (e.g., vehicles and machine, buildings, out farms, etc.) to allow them to confirm or not if individual controls were in place. The list of questions for each hazard was laid out in the order of the Hierarchy of Controls (found in Schedule 3 of SHWW Act 2005[3]) with physical controls listed first followed by safe work practices. The instruction sheet indicated that following consideration of each question, a farmer should indicate if a control measure was in place and if not, to list it on an Action list page. In contrast to previous Irish approaches with safety statement formats, no means of probabilistic risk assessment was included in the RAD, as the literature[17-19] indicates that humans have difficulty with making risk-related judgements based on probability. The approach adopted used the causes associated with fatal injury and ill-health as the basis of questions raised in the pilot RAD as an alternative to probabilistic risk assessment.

Table 1. Control measures specified by farmers in RADs (No. = 475).

RAD category (by order of %)	No.	%
Machinery	310	22.0
Tractors, farm vehicles, and ATV's	282	19.9
Livestock	206	14.7
Farmyard, buildings, and slurry	180	12.6
Electricity	125	8.8
Health	126	8.8
Chemicals	94	6.8
Workshop, repairs, working with timber	71	5.0
Children and older farmers	20	1.4
Total	1414	100

Methods

Within Irish agriculture, a wide range of farms occurs with varying socio-economic characteristics.[20] To study both RAD and training utility, voluntary collection of RADs took place in areas with farms of a wide variation in farm socio-economic characteristics (e.g., enterprise, scale, level of farm buildings, and machinery) with a total of 475 pilot RADs collected. A sample of 66 farmers was selected to audit from farmers who returned RADs, together with 28 RADs from farmers following participation in a 12.5 hour OHS course, giving a total of 94 farms. The farms for audit were selected randomly but purposefully to give a range by enterprise and scale, based on information in the RAD. Thus, the study applied a random but non-probabilistic approach to gaining a sample of farms to audit regarding RAD completion and implementation and overall farm OHS standards.

All farm audits were voluntary and took place about 6 to 12 months after RAD completion. Audits took place within 24–48 hours of the visit request to ensure no major changes in SHWW took place. Farm audits were undertaken by two persons, both of whom were qualified and experienced in farm OHS. An inspector from the HSA participated in 70% of farms audited on an advisory basis only; however, where issues arose

related to SHWW legal non-compliance, farmers were advised of the situation.

An assessment of elements of management of OHS on each farm was conducted and a score allocated to the various farm elements. Additionally, an overall safety score was then applied based on overall farm OHS standards. This safety score estimated the components and overall level of OHS management of the farm. The score used a 1, 2, 3, 4 scale representing "very satisfactory," "satisfactory," "unsatisfactory," and "very unsatisfactory," respectively. An audit-sheet describing key OSH requirements was developed and used to assist with applying safety scores consistently.

An assessment of implementation of controls was undertaken by examining if the controls listed in the RAD "Action list" page for implementation had in fact been implemented. A positive score (Yes = 1) was allocated when all controls listed which would warrant legal enforcement were in place and for other controls listed involving less hazard if these were implemented or where intention to implement them was explicitly demonstrated (e.g., machine part ordered). In contrast, a negative score (No = 2) was applied when the controls listed on the Action list were not implemented and where intention to implement them was not apparent.

The audit methods used in this study were informed by previous studies[21,22] that considered an auditor's expertise in the field of OHS as an essential component of auditing. It was found that availability of an audit check-sheet (Site Rank System) increased consistency in OHS scoring of farms.[22] These authors also noted that approximately one hour was sufficient to interview a farmer and conduct audits of the key equipment and facilities of the farm visited. Having an even scoring system with no mid-point is considered useful to facilitate auditor "decision making," and it also allows for consolidation of data by reducing scores to a lower number of categories if necessary (e.g., from four to two).[22,23]

In the case of this study, a four point scoring system was used for farm assessment, where scores were equated to the legal position under the SHWW Act (2005) with the highest score (score = 1) representing an **excellent** standard, a score of 2 an **acceptable** standard, a score of 3 represents where an **improvement notice** would be issued, and a score of 4 where **prohibition notice** would be served by a HSA inspector.

Definitions for dependent variables used in the study are described in Table 2 and are in line with those used by the Irish National Farm Survey[24] other than the following two variables: the score for "farmer attitude to OHS" was obtained by scoring a farmer's motivation for practical OHS adoption through audit questioning and observation of farm standards while the "farm work time" score was based on questioning the farmer on the farm work time required.

Regarding statistical testing in this study, SPSS Software package version 18 was used. The T-test for equality of means was used for mean comparisons in Table 2, and bivariate chi-square testing was used for testing for relationships between variables described in Table 4. Levels of significance are indicated as follows: * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$, and the notation 'n.s.' is used to indicate a non-significant finding.

Table 2. Comparison of mean number of controls specified in RAD following half-day training or not by farm enterprise type.

Farm enterprise	Training participation	Mean no. of controls	[a]*P* Value (Significance)
Dairying	Training (*n* = 143)	4.28	*P* = 0.002 **
	No training (*n* = 58)	2.24	
Drystock	Training (*n* = 153)	2.60	*P* = 0.06 n.s
	No training (*n* = 46)	1.84	
Tillage	Training (*n* = 39)	3.08	*P* = 0.09 n.s
	No training (*n* = 36)	2.55	
All	Training (*n* = 335)	3.32	*P* = 0.00 ***
	No training (*n* = 140)	1.95	

[a]T test for equality of means.
* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

Results

As indicated in Table 1, a total of 1,414 control measures were identified for action in 475 pilot RAD documents giving an average of three actions per farm with machinery having the highest frequency (22%), and "children and older farmers" having the lowest (1.4%). Further examination of the controls listed indicated that the majority (92.4%) were "physical" in nature, with 7.6% being "practice" related, which made up 27.4% of pilot RAD questions. Provision of half-day training on RAD completion[14] led to a 40% increase in RAD action measures identified. The dairying enterprise had the highest level of actions identified followed by tillage and drystock (beef cattle or sheep) (Table 2).

Scoring of farm OHS standards and practices based on farm audits is provided in Table 3. A score was allocated only if the issue arose on a farm, for instance the issues of "children" or "older farmer" arose on a farm in 36.2 and 24.5% of cases, respectively, where the score was applied. Overall farm scoring indicated an OHS compliance level of 76.6% of farms which achieved a satisfactory Safety Score. Thirty-three percent received the exemplary highest "1" score, and 43.6% the satisfactory "2" score; while 20.2% and 3.2%, respectively, received the unsatisfactory "3" and "4" scores.

Data for the relationship between farm safety score and farmer/farm variables are provided in Table 4. Of those who implemented the RAD controls, 92.1% had a satisfactory Safety Score, compared to 56.5% who did not implement the controls they specified ($P = 0.000$).

Overall, the level of implementation of RAD controls was 45.3%, which indicates limited implementation of OHS controls by farmers they had identified. Further analysis found that a positive OHS farmer attitude ($P = 0.003$) and increased farm size ($P = 0.026$) were the only variables studied which were positively associated with implementation of controls.

Farm enterprise was significantly associated with Safety Score as follows: dairy farms had a lower score, while tillage farms had a higher satisfactory score relative to drystock ($P = 0.011$). For "farm work time," where farmers ranked their farm as requiring high farm work time, the farms received a lower Safety Score ($P = 0.001$). Farmer age significantly influenced safety score with farmers in the middle age category (45–55 years) having a lower score than younger or older categories ($P = 0.029$).

Among a subgroup of farmers audited ($N = 28$), tutorial assistance had been offered with completion of the RAD. Half of these farmers ($N = 14$) availed of this assistance and half did not, while the two groups were similar in terms of enterprise farmed and scale. Among those who received tutorial assistance, 35.7% had implemented controls compared to 71.4% of

Table 3. Percentage distribution of farms (No. = 94) by safety score for SHWW farm audit.

Farm element scored	No. of farms	% In each category[a]				% Satisfactory[b] (A: 1&2)
		1	2	3	4	
Tractors/vehicles	94	41.4	55.3	2.2	1.1	96.7
Machinery	91	38.4	49.5	8.8	3.3	87.9
Livestock	81	27.2	58.0	13.6	1.2	85.2
Farmyard/buildings	93	40.9	41.8	11.8	5.5	82.8
Electrical	93	32.3	49.5	15.0	3.2	81.8
Workshop	68	23.5	64.8	8.8	2.9	88.2
Chainsaw	61	6.6	78.7	13.1	1.6	85.3
Chemicals	84	25.0	59.5	15.5	0.0	84.5
Health issues	94	24.5	64.9	10.6	0.0	89.4
Protective equipment	90	26.7	56.6	16.7	0.0	83.3
Children	34	17.6	76.5	5.9	0.0	94.1
Older farmer	23	17.4	78.2	4.4	0.0	95.6
Farmer OHS attitude	92	43.5	36.9	16.3	3.3	80.4
Safety score	94	33.0	43.6	20.2	3.2	76.6

[a]Score type: 1 = very satisfactory; 2 = satisfactory; 3 = unsatisfactory; 4 = very unsatisfactory.
[b]Score reclassification: A satisfactory (scores 1 and 2), B unsatisfactory (scores 3 and 4)
SHWW, safety, health and welfare at work; OHS, occupational health and safety.

Table 4. Relationship between farm safety score and farmer/farm variables.

			Farm OHS score (%) [a]		
Dependent variable/description		N	A Satisfactory	B Unsatisfactory	Significance[b]
Farmer attitude to OHS	Satisfactory (*N* = 73)	94	90.4	9.6	*P* = 0.000 ***
	Unsatisfactory (*N* = 21)		14.2	85.8	
Implemented OSH controls	Yes (1) (*N* = 38)	84	92.1	7.9	*P* = 0.000 ***
	No (2) (*N* = 46)		56.5	43.5	
Farm enterprise	Dairying (*N* = 35)	94	60.0	40.0	*P* = 0.011 *
	Drystock (*N* = 36)		72.2	27.8	
	Tillage (*N* = 23)		95.7	4.3	
Farm size. (Hectares)	0–39 (*N* = 19)	94	57.9	42.1	*P* = 0.177 n.s
	40–79 (*N* = 47)		74.5	25.5	
	80 + (*N* = 28)		82.1	17.9	
Farm economic size (ESU)	0–29 (*N* = 30)	94	70.0	30.0	*P* = 0.868 n.s
	30–59 (*N* = 25)		76.0	24.0	
	60+ (*N* = 39)		74.4	25.6	
Labor units	0–0.99 (*N* = 34)	94	73.5	26.5	*P* = 0.734. n.s.
	1–1.99 (*N* = 35)		77.1	22.9	
	2 > (*N* = 25)		68.0	32.0	
Farm worker status	Part-time (*N* = 24)	94	83.3	16.7	*P* = 0.439. n.s
	Full time (Ft) (*N* = 56)		69.6	30.4	
	Ft.& worker(s) (*N* = 14)		71.4	28.6	
Farm work time	High (*N* = 32)	94	53.1	46.9	*P* = 0.001**
	Low (*N* = 62)		83.9	16.1	
Farmer age (years)	<45 (*N* = 40)	94	77.5	22.5	*P* = 0.029*
	45–55 (*N* = 30)		56.7	43.3	
	55> (*N* = 24)		87.5	12.5	
No. of farm vehicles	1–2 (*N* = 45)	88	73.3	26.7	*P* = 0.908. n.s.
	3+ (*N* = 43)		74.4	25.6	
No. powered machines	0–4 (*N* = 37)	89	75.7	24.3	*P*= 0.636. n.s
	5+ (*N* = 52)		71.2	28.8	

OHS, occupational health and safety.
* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

those who had not received tutorial assistance, which was close to statistical significance ($p = 0.058$). Overall these data suggest that a high proportion of farmers who were challenged to implement on-farm OHS controls also sought assistance with RAD completion. This suggests that the limitations of these farmers have several dimensions including the capacity or confidence to complete the RAD and to implement OHS controls at farm level.

Discussion

The study found that Irish farmers perceive farm risks as principally physical in nature (Table 1), which co-relates with other studies. For instance, data for controls specified in the RAD are somewhat similar to findings of an earlier Irish study[12] where farmers were questioned on concerns about safety on their farms in a National Farm Survey of Safety and Health on Irish Farms. Farmers reported concerns related to farm vehicles and machinery (38.1%), electricity (12.0%), slurry related (9.0%), livestock related (9.2%), children on the farm (7.6%), and other concerns (23.3%). It is notable that "children on the farm" are proportionately higher in these data than in the RAD controls specified data (1.4% children/older) (Table 1), but otherwise similarities occurred related to farm vehicles and machinery (41.9%), electricity (8.8%), and livestock (14.7%). A recent Australian study[25] found that farmers predominantly perceived that farm risks were physical, with 60% being in this category, and among these, 38% were machinery related. Among perceived risks recorded in the Australian study, 3.5% related to children and older farmers made up the total, which is similar to the current study in terms of RAD controls specified. The Australian study indicates that the perceived risks identified by farmers are broadly similar to the RAD and the previous Irish study.

A further example is the issue of farmer "health," which obtained 8.8% of RAD controls

specified. However, an Irish study on mortality in the working population[26] indicates that farmers have considerably higher health related mortality than other occupational groups. The current study and comparisons with various studies related to farmers OHS risks indicate in particular that farmers have a high ongoing concern related to vehicle/machinery use, while areas such as child and older farmer safety and health, for example, receive limited concern. The finding that Irish farmers perceive farm risks as principally "physical" in nature is an important finding related to OHS promotion through extension in Ireland and suggests that further and nuanced extension approaches are needed to widen farmers perspectives related to OHS adoption.

Data in Table 3 provide an estimate of OHS adoption among the random sample of farms audited (N = 94) that had completed the RAD. The study data indicate a higher level of noncompliance compared to the findings from official HSA inspections for 2006,[27] where either a legally binding "prohibition" or "improvement" notice was served on 15.3%, and a written advice letter to a further 22.4% of farms inspected. Improvement and prohibition notice issue corresponds to scores of 3 and 4, respectively, as used in the on-farm scoring in this study, while issuing an advice letter corresponds to OHS issues associated with score 2, where improvement is advised but where a statutory breach of SHWW Act was not identified. A subsequent study as part of the PI indicated that farmers who completed the RAD were both larger in scale and more likely to be extension service clients, which could account for the higher OHS adoption rate in this study.[28]

Among individual farm elements scored during the farm audits undertaken as part of the study, tractors/vehicles had the highest scores of 96.7%, while farmyards and buildings and electrical standards had the lowest scores of 82.8% and 81.8%, respectively. In Ireland, considerable on-going investment in farm vehicles has been reported,[11] while the fitting of ROPS has been a legal requirement since the 1970s, which influenced the high tractors/vehicles score. However, it has been concluded in designing and implementing tractor/machinery injury prevention strategies that human factors, machinery and equipment standards/maintenance, and system factors all need to be considered.[29] Farm buildings and electrical installations on Irish farms have been erected and installed over many years, particularly since the 1960s when modernization of agriculture accelerated rapidly. While significant on-going investment in farm buildings is taking place, this is for new structures.[11] Thus, Irish farms have a mix of both new and old buildings and electrical installations which leads to varying OHS standards. Currently, the Irish government's Department of Agriculture, Food and the Marine (DAFM) has a grant scheme available (Targeted Agricultural Modernization Scheme—TAMS)[30] that provides funding for a wide range of OHS related farm buildings and infrastructure to assist with improvement of this issue. This scheme also requires applicants to have completed a RAD half-day training course within the previous 5 years.

The findings from the study related to farm OHS standards as measured through "Safety Score" and farm and farmer variables (Table 4) suggest that both a farmer's attitude to OHS and their capacity to implement OHS controls on an on-going basis are associated with achievement of satisfactory OHS standards. Prevention of the range of possible farm injuries requires the on-going implementation of a suitable range of both technical and behavioral solutions,[31] which suggests that the on-going OSH managerial input of the farmer is essential. Moreover, recent research in Canada[32] indicates that injury reduction is achieved when the majority of steps in the Hierarchy of Controls are applied at farm level, implying that both physical and organizational control implementation is needed to reduce injury. Thus, the current study suggests that positively influencing farmers' to adopt measures is a crucial requirement of successful extension programs in OHS. The study findings suggest that use of a RAD is helpful to those with the management capacity to implement controls but is of limited utility where this capacity was not present. This finding is in broad accord with adoption of innovations theory,[33] which suggests that within a population, there are innovators, early adopters, late adopters, and laggards in relation to adoption of particular practices.

The study data (Table 4) indicate that having knowledge *per se* does not necessarily lead to OHS adoption, as 55% of farmers did not implement the controls they identified as missing on their farms and specified for rectification on the RAD Action list. Of farmers who did not implement controls, 43.5% had an unsatisfactory Safety Score compared to 7.9% who did implement the controls. The implication of this finding is that extension OHS programs need to go beyond transmitting knowledge and need to apply strategies that encourage and ultimately motivate achievement of farmer adoption of good OHS practice. One possible approach for consideration is inclusion of OHS as a topic for farmer discussion group programs, as these have been shown to be efficient and effective means of farm technology and practice adoption in Ireland due to their practical on-farm interactive peer discussion and facilitated format.[34–36] In relation to OHS adoption, studies across a range of disciplines reported gains in risk reduction using participatory approaches with small groups.[37–42] In Ireland, the current DAFM Knowledge Transfer Programme[43] incentivizes farmer participation in discussion groups, and OHS is included as a mandatory component of the scheme. Knowledge Transfer Facilitators (Teagasc Advisers or private Consultants) are required to receive training to engage in farm OHS facilitation.

Regarding farm enterprise, dairy farming had the lowest percentage (60%) of satisfactory Safety Score compared to drystock (72.2%) and tillage (95.7%) farms. The finding for dairying may be explained by the fact that this enterprise was reported to have the highest labor input[11] compared to other livestock enterprises. Regarding tillage farming in Ireland, there has been a trend toward concentration of production on fewer farms that use labor efficient mechanization systems[20], consequently allowing more time and attention for OHS management.

The study also found that farmers in the mid-career category (45–55 years old) had the lowest Safety Score. This may be accounted for by the fact that this period of a farmers farming career may be at its busiest and most active.

Regarding farms on which there was a reported "high work time" requirement, these had a lower satisfactory Safety Score (53.1%) compared to farms requiring low work time (83.9%). Studies in Ireland have indicated that level of use of work time is associated with both farm technology and practice adoption,[44,45] which is a management attribute. Thus, this study finding supports the findings of other studies[46,47] that found farmers' capacity for OHS management was associated with their overall management capacity.

Conclusion

The principal study findings are summarized in Figure 1. The study data suggest that the RAD has utility in translating legal requirements into practical OHS knowledge for farmers; however, limited adoption arose from its use. This is particularly the case among farmers who are challenged

Principle Study Findings

- The study found that Irish farmers perceive farm risks as principally physical in nature.
- Of those who implemented RAD controls, 92.1% had a satisfactory Safety Score compared to 56.5% who did not implement the controls they specified.
- A positive OHS farmer attitude ($P = 0.003$) and increased farm size ($P = 0.026$) were the only variables studied which were positively associated with implementation of controls.
- Farmer age significantly influenced safety score with farmers in the middle age category (45 – 55 years) having a lower score than younger or older categories ($P = 0.029$).
- A high proportion of farmers who were challenged to implement on-farm OHS controls also sought assistance with RAD completion, suggesting that the limitations of these farmers have several dimensions including the capacity or confidence to complete the RAD and to implement OHS controls at farm level.
- The current study suggests that positively influencing farmers to adopt measures is a crucial requirement of extension programs in OHS . Study findings suggest that use of a RAD is helpful to those with the management capacity to implement controls but is of limited utility where this capacity is lacking.
- Having knowledge *per se* does not necessarily lead to OHS adoption, as 55% of fa rmers did not implement the controls they identified as missing on their farms.

Figure 1. Principal study findings.

to adopt OHS controls. The possibility of the use of social learning through discussion groups is suggested as an extension approach to increase OHS adoption associated with RAD use. The study data also suggest that to improve farm OHS, extension should adopt a broadly based approach to improve farmer managerial capabilities.

Based on the study, it is concluded that the coordinated approach to farm OHS improvement in place in Ireland described is in accord with the Socio-Ecological Model approach advocated in the literature.[48] This model defines various levels of the social environment such as at an intrapersonal, interpersonal, institutional, and cultural level that could be influential in injury and ill health reduction.

While the study obtained considerable new knowledge on farm OHS adoption based on use of the RAD, it has several limitations. Firstly the sample size (N = 94) of farms audited was limited due to available resources and, as a consequence, use of predictive statistical methods such as a multiple regression model could not be applied to this study data. The knowledge gained from this study could, however, provide insights for future studies on farm OHS adoption with larger farm audit sample numbers. Secondly, use of validated instruments to measure variables such as farmer "attitude" and "management capacity" related to OHS among larger samples could facilitate valid comparison among adoption studies in this field.

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Acute Pesticide-Related Illness Among Farmworkers: Barriers to Reporting to Public Health Authorities

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ABSTRACT

Farmworkers are at high risk of acute occupational pesticide-related illness (AOPI) and AOPI surveillance is vital to preventing these illnesses. Data on such illnesses are collected and analyzed to identify high-risk groups, high-risk pesticides, and root causes. Interventions to address these risks and root causes include farmworker outreach, education, and regulation. Unfortunately, it is well known that AOPI is underreported, meaning that the true burden of this condition remains unknown. This article reviews the barriers to reporting of farmworker AOPI to public health authorities and provides some practical solutions. Information is presented using the social-ecological model spheres of influence. Factors that contribute to farmworker AOPI underreporting include fear of job loss or deportation, limited English proficiency (LEP), limited access to health care, lack of clinician recognition of AOPI, farmworker ineligibility for workers' compensation (WC) benefits in many states, insufficient resources to conduct AOPI surveillance, and constraints in coordinating AOPI investigations across state agencies. Solutions to address these barriers include: emphasizing that employers encourage farmworkers to report safety concerns; raising farmworker awareness of federally qualified health centers (FQHCs) and increasing the availability of these clinics; improving environmental toxicology training to health-care students and professionals; encouraging government agencies to investigate pesticide complaints and provide easy-to-read reports of investigation findings; fostering public health reporting from electronic medical records, poison control centers (PCCs), and WC; expanding and strengthening AOPI state-based surveillance programs; and developing interagency agreements to outline the roles and responsibilities of each state agency involved with pesticide safety.

KEYWORDS

Agriculture; farmworker; occupational; pesticides; poisoning; surveillance; underreporting

Introduction

Farmworkers are at high risk of acute occupational pesticide-related illness (AOPI) and AOPI surveillance is vital to preventing these illnesses. Data on such illnesses are collected and analyzed by public health authorities at the local, state, and federal levels. Surveillance findings are used to identify high-risk groups, high-risk pesticides, and root causes. Interventions to address root causes and reduce risks include stakeholder outreach, education, and regulation.

The problem of underreporting of AOPI to public health authorities is well-known,[1] and this hampers the effective operation of AOPI surveillance. Farmworkers are vulnerable and economically disadvantaged and this compounds the underreporting of farmworker AOPI. Farm work is among the lowest paid jobs in the United States,[2] is physically laborious, and offers little job security. Many jobs in agriculture are temporary, and farmworker unemployment is double that of all other wage and salary workers.[3] Among farmworkers employed in the United States, approximately 68% were born in Mexico, 27% in the United States, 4% in Central American countries, and 1% elsewhere.[4] About half of all agricultural workers lack proper documentation to legally reside and work in the United States, and these workers have a strong fear of deportation.[5] Many farmworkers also have limited English proficiency (LEP), and

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70% speak little or no English.[6] Approximately 72% of farmworkers did not complete twelfth grade, including 36% of them who completed sixth grade or less, and 3% having no formal schooling.[4]

It is estimated that as many as 88% of AOPI cases among farmworkers are not reported to the public health authorities.[1] Factors that contribute to the underreporting of work-related conditions of public health significance, such as AOPI, include the following: a person fails to perceive that they have a treatable condition, the affected person doesn't seek care, the person is misdiagnosed, the clinician fails to take an occupational history and fails to recognize that the condition is work-related, and the clinician fails to comply with the legal requirements to report the illness to public health authorities.[7] These factors may be more prevalent among farmworkers compared to other US workers due to farmworkers often having lower levels of formal education, LEP, and undocumented immigration status.[8] An additional factor in underreporting is the lack of a national mandatory requirement to report acute pesticide-related illness to public health authorities, although such a requirement exits in 30 states.[9]

This article reviews the barriers to public health reporting of farmworker AOPI and provides some practical solutions. Information is presented using the social-ecological model spheres of influence.

Methods

The findings in this article are based on the authors' decades of experience in AOPI surveillance, and on supporting documentation found in the literature. The supporting literature was identified by one or more of the authors being aware of it or by searching PubMed using search terms relevant for the specific documentation being pursued. Examples of the search terms used are 'limited English proficiency, agricultural worker, language barrier, rural, health care, and underreporting'.

Results

Reporting barriers due to fear

Farmworkers have identified fear of job loss, demotion, and the reduced chance of being rehired in subsequent seasons as barriers to reporting both unsafe work conditions and AOPI.[10] Farmworkers are aware of the precarious nature of their jobs and understandably do not want to appear to their boss as 'complainers' and so may refrain from bringing up concerns about unsafe conditions and illness. Poverty and job insecurity are strong motivators for farmworkers to retain their employment, even when the job presents unreasonable health and safety risks.

Although the H-2A temporary agricultural workers program, where US employers can bring nonimmigrant foreign workers to the United States to work for that US employer only, mitigates deportation fears, it may not address other fears.[11] Guest workers who hold H-2A visas are considered legal residents and therefore are at low risk of deportation. However, because H-2A workers may desire to participate in the H-2A program in subsequent years, and because they may have LEP, these guest workers are also unlikely to complain about unsafe working conditions, ill health, or low pay.

Some of the described fears are not unfounded. Although laws exist to protect 'whistleblowers' (i.e., those who report employer wrongdoing) from unfair firing, they are often difficult to enforce.[12] Furthermore, farmworkers are excluded from the right to engage in union activity without retaliation from their employers (National Labor Relations Act 1935, 29 USC § 151), but some states have laws to provide this right (e.g., WA).[13] Because federal law does not protect farmworkers' right to join a union or engage in collective bargaining, they may be unable to use collective action to raise wages or to improve unsafe working conditions.

Reporting barriers due to LEP and lack of formal education

When AOPI occurs, LEP and lack of formal education limit not only how a farmworker can get help, but also how much help clinicians and state agencies can provide.

Farmworkers unable to get help

Language barriers present obstacles to effective pesticide safety training and to adequate medical care after a pesticide exposure. Even when training is in

a farmworker's primary language, he or she might have difficulty understanding the content.[14,15] For example, a silent video that conveys information using bulleted statements may be difficult for individuals with poor reading proficiency to comprehend, especially if technical language is used. LEP patients have indicated that language can be problematic when making an appointment, discussing ailments at a doctor's visit, and following post-appointment instructions.[16] These problems are compounded by the seasonality of work, which often forces farmworkers to be migratory.[17–19] This compromises continuity of care because with each change of address, the farmworker must find a new health-care provider, quite possibly in an area where the individual is unfamiliar with local health-care resources.

Providers unable to help

As for health-care providers, many clinics or hospitals do not meet the National Standards for Culturally and Linguistically Appropriate Services (CLAS standards) in health care.[20,21] Federal CLAS standards mandate health-care organizations to make timely language assistance available to LEP patients at no cost, inform LEP patients of their right to receive language services, have patient information written in languages commonly seen and served, and avoid using family and friends as interpreters (i.e., reliance on family members as interpreters should be avoided because it can increase the risk of medical errors, the patient may not want to share sensitive health information with a family member, and the interpreter may not understand medical terminology).[21] A provider might prefer to avoid using time-consuming interpreter services so he or she can maintain tight patient visit schedules. Even when interpreter services are provided, interpreted sessions between clinicians and patients can be awkward and prolonged.[22]

Reporting barriers related to access to health care

Health-care access for farmworkers is a major problem.[23] Factors affecting agricultural workers' access to health care are complex, but can include the role of a supervisor, long distances to the nearest clinic, high cost, worker mistrust of health-care providers, and ineligibility for workers' compensation (WC).

Role of a supervisor

A farm owner or crew supervisor can impede or facilitate worker access to health care after a worksite injury. Anecdotal evidence from state surveillance agencies indicate some supervisors have provided or secured transportation for injured workers and assured that health-care providers had pesticide name information necessary to treat, and others have not.[24]

Distance to the nearest clinic

Primary-care provider shortage and remote locations compound the problem of health-care access.[25,26] Given the low density of clinics in US rural areas, farmworkers must sometimes travel great distances to obtain health care. Covering these long distances to reach a clinic is especially problematic because few farmworkers have access to personal automobiles.[27]

In addition to distance and transportation difficulties, clinics being closed during the farmworkers' off-duty hours present practical barriers to care. Farmworkers have long and irregular working hours, while clinics often have an 8 AM to 5 PM schedule. Hospital emergency rooms may be an option, but risk becoming overburdened by the demands of nonemergency patient care.

High cost of care and lack of insurance

According to the 2009 California Health Interview Survey, 67% of documented immigrants and 82% of undocumented immigrants delayed getting needed medical care in the 12 months preceding the interview because of cost or lack of insurance.[28] Furthermore, noncitizens and their children are less likely to have health insurance[29], and among those with health insurance, it is often a high-deductible health plan requiring at least $1000 of out-of-pocket expenses before insurance coverage commences.[30]

Federally qualified health centers (FQHCs) have sliding-scale fees, which makes health care more affordable for farmworkers.[31] Unfortunately, farmworkers may not be aware of FQHCs or there may not be a nearby FQHC.

Mistrust of health-care providers

Although honesty, communication, and competence are important characteristics of high-quality medical care, such traits are difficult to measure.[32] Mistrust of the health-care system, which appears to be higher among individuals who are uninsured or between 31 and 60 years old, may lead to poor health and reduced or delayed utilization of medical services.[33] In a systematic review of access to health-care services, clinicians perceived that patient mistrust was especially high when patients were unfamiliar with the local health-care system.[34] Among undocumented workers, fear of being reported to government authorities may contribute to patient mistrust; however, such reporting by clinicians is uncommon.[34]

Reporting barriers due to clinicians not recognizing and reporting AOPI

Clinicians often do not correctly diagnose AOPI, leading to underreporting to public health authorities.[35] There are several reasons for this. First, health-care professionals rarely receive training in collecting environmental and occupational histories, and it is uncommon for them to receive instruction on environmental and pesticide toxicology.[36] As such, clinicians may not collect the environmental and occupational history needed to determine the causal agent of a patient's illness. Other reasons that AOPI is rarely recognized are because pesticide poisoning is relatively rare in developed countries, and its signs and symptoms often resemble those of more common conditions. Often these common conditions (e.g., upper airway irritation or gastroenteritis) may be preferentially diagnosed. Furthermore, laboratory tests to confirm an AOPI diagnosis are rarely available. Clinicians often prefer that their suspicions of an occupational illness be confirmed by a laboratory test. When such tests are unavailable, it weakens the clinician's resolve to report the case to public health authorities. In addition, clinicians may be concerned about potential Health Insurance Portability and Accountability Act (HIPAA) violations if they report an illness to public health authorities, and may not be familiar with the HIPAA exceptions (described later in this article).[37] Primary-care providers and their staff may also be too busy to report an illness to public health authorities; they may see their priority as providing medical care, with public health prevention being of secondary importance. Finally, even when correctly diagnosed, some patients may not be reported to public health authorities because of a lack of understanding of the requirement or because the clinicians fear that they or their patients may be subject to retaliation. A type of retaliation that a clinician can experience is loss of business. If an employer is unhappy that a clinician submitted an illness report to public health authorities, the employer might cease sending its employees to the clinician who had been providing acute care and medical clearance evaluations.

Barriers to use of WC

WC is a type of insurance that provides wage replacement and medical benefits to employees who are injured or become ill at work. WC filing requirements vary by state and industry sector, which limits the usefulness of these data for occupational health research and surveillance.[38,39] For example, at least 18 states do not require agricultural employers to have WC coverage (Table 1). Although the H-2A temporary foreign agricultural worker visa requires employers to provide WC to these workers, it covers only approximately 150,000 of the estimated 1–2 million seasonal and migrant farmworkers.[23] The number of agricultural workers with an H-2A visa doubled between 2012 and 2016, reflecting a positive trend in the numbers of agricultural workers with WC coverage.

WC awareness and low-severity illness

In Washington, it has been estimated that 16% of the workers were unaware of WC coverage and 8% of the workers feared employer retaliation and therefore did not file WC claims.[43] Compared to other occupations, those who worked in agriculture, forestry, or fishing ranked higher in work-related injury or illness reporting but lower in WC claims filing.[43] Low illness severity, as measured by time spent away from work or site-specific disability, has also been linked to patients not filing WC claims.[44–46] Although AOPI was not included in those studies, a majority of known cases are classified as low severity.[47]

Table 1. Workers' Compensation (WC) coverage requirements for farmworkers by state, 2016.

Agricultural Employer WC Coverage Requirements [a]	Conditions for Agricultural Employer Exclusion[a,b]	States														
Voluntary	Not applicable	AL	AR	DE	IN	KS	KY	MS	NE	NV	NM	ND	RI	SC	TN	
Elective	Not applicable	MI	NJ	TX	WY											
Compulsory	None	AZ	CA	CT	DC	HI	ID	MA	NH	OR						
Compulsory	Unspecified	UT														
		1 Exclusion						2 Exclusions[c]						3 Exclusions[c]		
Compulsory	Earnings or payroll threshold	CO	IA	NY	OK	VT		AK	PA	MN	LA			MD		
	Number of employees threshold	VA	WV	NC							FL	ME		MD	WI	
	Part-time or temporary work	IL	MI	MT					PA		FL	ME			WI	
	Nature of work [d]	SD	GA					AK			LA			MD		
	Family farm	OH	WA							MN					WI	

[a]Coverage requirements include: compulsory – agricultural workers are covered the same as all other employees; elective – agricultural employers may accept or reject the statutory provisions, but if rejected, the employer loses the three common-law defenses: contributory negligence, assumption of risk, and negligence of fellow employees. Given the risks of not being covered by these three common-law defenses, agricultural employers generally accept the statutory provisions; voluntary – agricultural employers are permitted to secure coverage voluntarily, even though no statutory provisions are prescribed. In states with voluntary requirements, employers who reject workers' compensation choose between personal liability and purchasing general liability insurance.[40,41] The WC coverage requirement categorizations reflect a review of two national reports with listings by state. [40,42] A more detailed and in-depth state-by-state analysis of WC laws may produce slightly different findings.

[b]Some states that have compulsory requirements provide exclusions whereby some farmworkers are not required to be covered by workers' compensation. This column provides details on those exclusions.[42]

[c]State names listed more than once in a column reflect multiple exclusions for that state.

[d]For example, conditions for agricultural employer exclusions in South Dakota are 'based on the predominant nature of the employee's work, and the employer's business. No exclusion if primarily in the business of operating threshing machines, grain combines, corn shellers, cornhuskers, shredders, silage cutters, and seed hurlers for profit'.[42]

Barriers to provider use of the WC system

A survey of 62 medical directors and administrators in Massachusetts revealed that more than 60% identified uncertainty about work-relatedness and lack of familiarity with WC system as factors that 'somewhat' or 'very much' discouraged use of WC at community health centers.[48] In addition, delayed reimbursement either 'somewhat' or 'very much' discouraged use of WC by 54% of administrators and 22% of medical directors.[48] Another important source of WC underreporting is that the clinician must recognize a condition as being work-related and document this in the medical record.[48,49] As explained earlier, an occupational etiology is often unrecognized because an occupational history is not collected. Such documentation is also important for billing. The billing staff is required to be sure that the work-relatedness of the condition is reflected in the medical record before they can justify invoicing WC for medical services.

Reporting barriers related to state agencies

In at least 13 states, the state health department conducts pesticide poisoning surveillance activities, which are performed in collaboration with other state agencies. State interagency coordination is necessary for the identification and efficient investigation of pesticide poisoning case reports, and also for appropriate follow-back to responsible parties for prevention. These other state agencies often include state agriculture departments, state environmental protection departments, and state labor departments.

Although each of these agencies serves an important role in protecting farmworkers from pesticide exposure and pesticide-related illnesses, there are constraints that hamper state interagency coordination. For example, although the HIPAA privacy rule under the public health exception permits health-care providers to disclose personal identifiers without individual authorization to public health authorities, this exemption doesn't apply to health departments interested in sharing those personal identifiers with other state agencies. That is, state health departments are prohibited from sharing personal identifiers (e.g., name, address, phone number) with other state agencies unless there is permissible state law, a memorandum or interagency agreement between the two agencies, or the exposed/ill person has provided consent either verbally or in writing.[37] The dueling responsibilities of protecting public health and protecting a farmworker's identity must be carefully considered. It is important to protect the

farmworker's identity from being divulged to the employer, thereby preventing retaliation against the employee, but it is also important to avoid impeding efficient and effective public health collaboration across state agencies. When state health departments share identifiers with other state agencies, appropriate safeguards are needed to prevent disclosures inconsistent with the interagency agreement and to minimize the possibility of retaliation against the farmworker.

Staff shortages and lack of resources also limit the scope of state-based surveillance activities. For example, among the 13 states that support pesticide-related illness surveillance programs, at least three exclude nonoccupational cases of pesticide-related illness and injury from their surveillance activities (i.e., Iowa, Nebraska, and Texas). In the other 10 states, resources are conserved by excluding some low-severity cases from follow-up activities or excluding disinfectants from surveillance. In addition, because of inadequate staffing and resources, agreements that are needed for interagency collaboration are often never developed.

Occupational safety and health administration

OSHA, an agency of the US Department of Labor, ensures safe working conditions by setting and enforcing standards and by providing training and assistance to workers and employers. In 28 states, OSHA directly covers workers, while in the other 22 states, workers are covered through an OSHA-approved State Plan.[50] In the agricultural industry, OSHA and OSHA-approved State Plans regulate hazard communication, farm labor housing, and field sanitation. In most states, OSHA and OSHA-approved State Plans are prohibited from enforcing these regulations on farms with 11 or fewer employees. Because most agricultural workplaces have 11 employees or less, many farmworkers are not afforded OSHA protections. Washington State and California are exceptions, as all farmworkers in those states are protected by OSHA regulations, regardless of employer size.[51]

Practical solutions

Each step in the sequence from farmworker pesticide exposure to successful classification of a confirmed AOPI case by public health authorities is beset with barriers. Practical solutions to address many of these barriers are provided in Table 2, sorted by the levels of the social-ecological model of change.[52] Below we elaborate on some of the more important solutions, which are organized along a continuum ranging from public health policy promulgated at the federal level to actions undertaken by individuals.

Policy-level interventions (i.e., federal and state regulations) can involve expanding WC coverage to include all farmworkers and expanding farmworkers' rights to engage in union activity to protect these workers against retaliation. Surveillance systems that track AOPI (e.g., the SENSOR-Pesticides program) can be expanded to new states and strengthened in currently participating states.[53] Better collaborations between state health departments and other relevant state agencies (e.g., poison control centers [PCCs], WC agencies, and state departments of agriculture) can improve the success of surveillance systems. To establish these collaborations, these other state agencies also need expanded resources and staffing. Multiagency coordinating boards and advisory committees could be fostered that function to coordinate investigations and report findings of AOPI investigations. An example is the Pesticide Analytical and Response Center Panel in Oregon.[54] Measures can also be taken to automate prompt reporting to state health departments from PCCs and WC insurers. This could increase the volume and timeliness of reports, allowing state agencies to more quickly initiate investigations and interventions.

State agriculture departments are often the lead agency in a state that regulates pesticides, functioning as the Environmental Protection Agency designee for enforcement of the Federal Insecticide Fungicide and Rodenticide Act (FIFRA). They conduct inspections and investigate pesticide-related complaints, interpret pesticide compliance requirements, issue penalties when violations are identified, and enforce the Federal Worker Protection Standards (WPS). Given their important role in ensuring safe pesticide use, state agriculture department staff should be trained on the value of AOPI reporting to recognize how their actions can contribute to successful reporting, improved surveillance, and illness prevention.

Table 2. The social-ecological model for barriers to reporting of acute farmworker pesticide-related illness to public health authorities.

Sphere of influence	Reporting barriers	Recommendations for improvement
Policy (e.g., local, state, and federal laws and regulations)	1. Immigration status: undocumented and H-2A temporary agricultural workers' fear of deportation	1. Farmworkers can be better protected by whistleblower laws
	2. Difficulty in enforcing laws protecting farmworkers from unfair job termination	2. Expansion of workers' compensation coverage to include farmworkers
	3. Farmworkers ineligible for workers' compensation in many states	3. Expansion of farmworkers' rights to engage in union activity
	4. Federal law does not protect farmworkers' rights to join a union or engage in collective bargaining	4. Surveillance systems that track acute pesticide-related illness (e.g., the SENSOR-Pesticides program) can be expanded to new states and strengthened in currently participating states
	5. State AOPI reporting requirement in 29 states, of which only 13 are part of the national surveillance program (i.e., SENSOR-Pesticides)	
Organizational (e.g., local health departments, health-care systems, and farmworker employers)	1. Fear of job loss and demotion	1. Employers can encourage, empower, and reward workers who report safety concerns
	2. Underreporting of pesticide poisonings by clinicians	2. Clinicians and patients can be encouraged to contact their PCC to report AOPI
	3. Constraints in interagency collaboration among state agencies	3. Adoption of electronic medical records, PCC data, and workers' compensation data to improve reporting
	4. Limited resources and expertise to conduct surveillance and reporting	4. Ensure adequate staffing of state government agencies, some of whom are bilingual
	5. Limited access to health care due to high cost, lack of insurance, remote location, and unavailability of transportation	5. Establish interagency agreements that outline the specific roles and responsibilities of each state agency
		6. Provide mobile clinics at farmworker labor camps, or transportation can be provided to the clinic.
		7. Raise awareness of federally funded community and migrant health centers, and increase the availability of such clinics
		8. Promote use of telemedicine, which allows clinicians to provide remote diagnosis and treatment through telecommunications technology
Community (e.g., schools, community advocacy groups, media, faith-based organizations)	1. Limited access to community resources, e.g., migrant workers are unfamiliar with local health-care resources	1. Remote deployment of teams made up of nonphysician and lay health workers (promotores de salud) to provide supportive services
Interpersonal (e.g., health-care providers, community health workers, or promoters)	1. Clinician failure to obtain a relevant occupational and environmental history and difficulty in recognizing AOPI	1. Provide greater access to in-person and online training about pesticide-related illness to health-care students and professionals
	2. Clinician failure to report AOPI to public health authorities	2. Periodically send physicians a reminder on the legal obligation to report AOPI
	3. Limited English proficiency	3. Enhanced interpreter services and training to overcome language barriers and increasing pesticide-related illness reporting in health-care settings
Individual (e.g., knowledge, skills, beliefs, attitude, developmental history)	1. Fear of retaliation (e.g., job loss, demotion)	1. Enlightened employers can encourage, empower, and reward workers who report safety concerns
	2. Lack of education and job skills	2. Effective implementation of revised Worker Protection Standard (WPS) with its expanded training requirements
	3. Lack of farmworker understanding of pesticide toxicity and their civil rights	3. Farmworkers can obtain objective evidence (video recording or photos) about pesticide exposure, which helps them move forward with a complaint.
	4. Acceptance of unsafe working conditions due to poverty and job insecurity	4. Government agencies might investigate all pesticide-related complaints and provide easy-to-read reports of investigation findings
	5. Distrust towards health-care providers and government officials	

AOPI = acute occupational pesticide-related illness

Migrant health centers are a special type of Health Resources and Services Administration (HRSA)-funded health center. Migrant health centers work to mitigate challenges to health care faced by many migrant workers, such as transportation, language access, cost, and clinic operating hours. There are currently 174 migrant health centers nationwide that serve 891,000 farmworkers and their families.[51] Additionally, because most farmworkers lack health insurance and their average wages are near the federal poverty line, migrant health centers offer care on a sliding fee scale.[52]

The WPS is a regulation under FIFRA that is aimed at reducing the risk of pesticide poisoning and injury among agricultural workers and pesticide handlers. Revisions to the WPS were finalized in 2015 to address the root causes for the persistently elevated farmworker AOPI rates.[55] Among the many WPS enhancements adopted in 2015 was an increased training frequency (i.e., annually instead of every 5 years) and expanded training content that should help prevent acute pesticide-related illness.[56] When such illnesses occur, the training should also help farmworkers recognize AOPI and seek treatment more quickly. In addition to the *policy* level, smooth adoption of the revised WPS will also influence other levels within the social-ecological model of change framework. For example, ensuring that workers are effectively trained on how to prevent pesticide exposure, and how to recognize and appropriately respond when they may have a pesticide-related illness, will influence the *organizational* and *individual* levels.

At the *organizational level* (e.g., health-care systems and farmworker employers), employers are responsible for maintaining a safe worksite. Enlightened employers can encourage, empower, and reward workers who report safety concerns to their supervisors. Employers may be perceived as more supportive and trustworthy when they encourage their workers to report safety problems and work-related illness and injury. Farmworkers may need transportation to medical care after a work-site injury. Supervisors are uniquely positioned to facilitate that transportation and to ensure emergency medical staff are provided with the information about the pesticide involved and the exposure scenario. Transportation issues can be reduced for ongoing and preventive care through more mobile clinics and community health fairs.

Interpersonal-level interventions (e.g., those involving clinicians, family, and peer groups) include providing enhanced interpreter services and training to overcome language barriers in health-care settings. Telephone interpreters can be used when in-person interpreters are unavailable, and providers can be encouraged to spend more time with patients during interpreted encounters.[21,57] Another solution to overcome long distances to the nearest clinic is the use of telemedicine, which allows clinicians to provide remote diagnosis and treatment through telecommunications technology.

Individual-level interventions (e.g., farmworker knowledge, skills, beliefs) can include having government authorities investigate all pesticide-related complaints made by farmworkers, and when an investigation is completed, farmworkers should be provided with an easy-to-read report that summarizes the investigation findings. These can serve as an important visible outcome for workers (and clinicians) to demonstrate that their complaints aren't being ignored and that action was taken. The near-ubiquitous use of cell phones, with their capacity for real-time streaming and video recording, is an empowering tool that may encourage expanded reporting to government agencies. Video recording and photos can provide objective evidence that a farmworker was exposed to pesticides (e.g., recording an off-target pesticide drift event), and this evidence may fortify the resolve of a worker to move forward with a complaint.

Conclusion

Improved public health reporting of farmworker AOPI is vital to the accurate determination of the magnitude, characteristics, and root causes of this condition. Once the root causes have been ascertained, interventions can be targeted toward their mitigation. This article reviews the many barriers that hamper reporting of farmworker AOPI to public health authorities and suggests some practical solutions. Implementing these solutions should result in a safer and healthier agricultural workforce.

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Caring for Children While Working in Agriculture—The Perspective of Farmworker Parents

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ABSTRACT

Access to safe, off-farm childcare is often a challenge for farmworkers with young children and is likely to become an increasingly salient barrier as more agricultural workers migrate together with families and as the number of women entering the agricultural workforce increases. Agriculture is one of the most hazardous industries, and the presence of young children in the workplace puts them at risk. To better understand the current nature of childcare for farmworker families and the challenges to accessing services, this project facilitated in-person surveys with 132 parents in three communities in Florida. A convenience sample that intentionally targeted parents living and working in areas with limited access to Migrant and Seasonal Head Start facilities was used to recruit participants. Most participants reported childcare access as a challenge. They expressed a desire to work in an area based on childcare availability. These findings offer agribusiness leaders important data to consider. They also suggest that industry support of childcare may be an important workforce investment. Findings indicate that high quality, affordable off-farm childcare services could serve as a means for attracting farmworkers to regions currently experiencing labor shortages. Additional research is warranted to explore this subject in diverse geographic areas.

KEYWORDS

Agriculture; child care; farm workers; parents; socio-ecological model

Introduction and background

There are an estimated 1.8–2.5 million migrant and seasonal farmworkers in the United States,[1,2] and more than half of these workers have minor children.[3] Agriculture poses numerous risks to workers, where hazards include machinery, livestock, and exposure to pesticides and other chemicals.[4] Access to off-farm childcare is a vital component of safeguarding children while parents work in agriculture. An estimated 60% of injuries to children on farms are among nonworking children who face many of the same risks as adult workers.[5] Yet, for many reasons, children are often brought into the agricultural work site by farm operators and employees.

According to the National Agricultural Worker Survey (NAWS), an employment-based, random-sample survey of US crop workers that collects demographic-, employment-, and health-related data in face-to-face interviews, the number of farmworkers traveling with their families in the United States is increasing, and more women are entering the agricultural workforce.[3] Recent NAWS data indicates that 28% of farmworkers are female,[3] compared to only 21% in 2001–2002.[6] Findings indicate that more women would be interested in agricultural employment if childcare options were accessible[7]; therefore, childcare is likely to become an increasingly salient issue among women seeking employment in agriculture. Florida-specific farmworker data is not readily available, but the team feels that the NAWS findings are generalizable to the target population for this in-person survey.

This paper considers the uniquely vulnerable position of farmworker children and their parents within the context of the socio-ecological model (SEM). The SEM recognizes multiple dimensions and how agents at various levels affect the individual in different ways.[8] This project works to impact the safety of children by targeting agents at various levels of the model. Agents will refer to adult (parents, individual growers), community

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(childcare providers), and institution/organization (national organizations of migrant childcare providers and agribusiness leaders).

Protecting Children While Parents Work is a joint collaboration of the Migrant Clinicians Network and the National Children's Center for Rural and Agricultural Health and Safety, funded by the National Institute for Occupational Safety and Health (NIOSH). The overall goal of this project is to improve access to childcare services for children of migrant and seasonal agricultural workers. A five member expert advisory committee guides the project and includes leaders from agribusiness, Migrant and Seasonal Head Start (MSHS) and the childcare community, as well as migrant health and child safety health experts in academia.

The overall goal of the project is to identify common ground among three key stakeholders: parents, childcare providers, and agricultural employers to address the safety needs of children. Ultimately, the team hopes to foster an increase in the availability of and access to off-farm childcare services for migrant and immigrant agricultural workers by bringing together these three stakeholder groups and establishing improved communication strategies (see Figure 1).

Preliminary data

As part of an extensive and multilevel assessment, the project team gathered data and obtained input from all the three stakeholder groups. Agribusiness employers have expressed an interest in how childcare availability affects employee retention and productivity. Attracting new employees and retaining current employees has become an increasingly critical issue as the national agricultural labor shortage continues across the United States.[9] The executive director of the National MSHS Association serves on the advisory committee for this project and facilitated access to MSHS parents to help form a base of knowledge regarding childcare for farmworker parents. The team felt that MSHS was an ideal partner for this project because of their broad reach among migrant families. The project team visited MSHS locations in various regions of the country and interviewed childcare provider staff at these locations. These site visits and semi-structured interviews offered insight into the services available to farmworker parents and the perspectives of and challenges facing childcare providers.

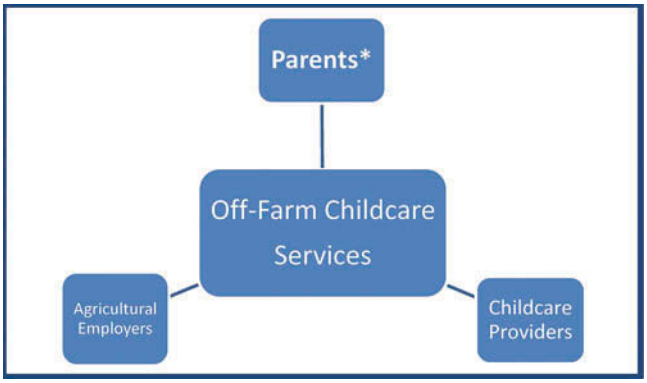

Figure 1. Protecting children while parents work project: Stakeholders. (*While this project involves all stakeholder groups, this manuscript focuses on the parent perspective gathered via in-person interviews).

One of the biggest challenges discovered during the preliminary childcare center site visits was limited funding including obtaining supplemental funds and restrictions on their use. For example, MSHS centers are required to enroll children according to strict eligibility criteria, and only a limited number of spaces for migrant children and seasonal children are available; the childcare centers do not have the autonomy to accept children based on need alone. Centers often receive funding from various sources (e.g., MSHS, private donations, and state-funded), and in some cases funds have preconditions and families may not meet the criteria. For example, there is eligibility criteria based on the type of agriculture in which the parents are employed; in some cases dairy and poultry workers are not included under the umbrella of migrant or seasonal workers because they remain in the same location year round and are excluded from childcare services. Additionally, a specified percentage of a family's income must come from agriculture to qualify for childcare services. Childcare offerings for agricultural workers vary state by state. For example, year-round dairy and poultry workers in New York are able to receive subsidized childcare because in addition to the funds from MSHS, the state supplements the cost of childcare.

During the preliminary site visits, childcare providers also reported a number of barriers to care including child provider ratios, child age, and immigration status. Childcare providers must

meet ratios that limit the number of children that can be in the care of one adult. Child age can be a limiting factor for both parents and providers because if a care provider accepts newborns, they are restricted to care for fewer children overall because newborns require a lower child-to-provider ratio. It is important to note that meeting child-to-provider ratios is commonplace in most childcare settings and is not unique to MSHS. Childcare providers also reported undocumented parents being wary of providing personal information which can make enrollment challenging.

The project team conducted an initial focus group among 15 farmworker parents in attendance at the National MSHS Association meeting in Washington, DC to begin learning more about the parent perspective. The purpose of this focus group was to gain a basic understanding of the challenges facing farmworker parents and help frame the content of a more targeted in-person survey. This first focus group was coordinated with MSHS parents because the project team wanted to connect with parents who understood the landscape of migrant childcare in various regions. This focus group was facilitated among parents who were already well-connected with MSHS and used its childcare services in different locations where they worked. The focus group identified the foremost challenges to obtaining childcare, including transportation, limited spaces at childcare centers, and lack of services in rural areas. Participants also shared observations and anecdotes that children were sometimes brought to the worksite when childcare was unavailable, and they expressed concern about hazards such as heat and pesticides.

The focus group, site visits, and informational interviews were pivotal in identifying some of the main barriers to accessing childcare and forming a better understanding of the current landscape of migrant childcare in the United States, allowing the team to develop a targeted in-person survey. The team partnered with Farmworker Association of Florida (FWAF) to administer the survey, which facilitated access to areas not saturated with formal childcare options.

Methods

The project team gathered farmworker parent perspectives using qualitative methods for the initial focus group and quantitative methods for the in-person surveys administered among farmworker parents. Interview tools were developed with the expertise of the project's advisory team. All research activities were approved by the Marshfield Clinic Institutional Review Board.

The aim of the in-person surveys was to better understand farmworkers' access to childcare. It was implemented in partnership with the FWAF in Apopka, Immokalee, and Quincy, Florida. These communities were identified by the FWAF as areas that are not saturated with formal childcare options for farmworker families.

Instrument

The 23-item in-person survey tool was initially translated from English to Spanish by a Spanish-speaking researcher and then reviewed by a team of three community health workers (CHWs) based in locations where data collection was to occur. The instrument collected the following data: demographics, including gender, age, and number of children (3 items); occupational history, including type of agriculture, years working in agriculture, and years with current employer (3 items); current practices surrounding and attitudes towards childcare (12 items); challenges and strategies to accessing childcare (3 items); communication preferences (2 items); and one open-ended question dedicated to participant comments. Upon consensus of the translation, the interview tool was back-translated into English by a native English-speaker for validation. The interviews were conducted in Spanish and used a verbal informed consent process. A signature waiver was granted due to the vulnerabilities of the target population.

Data collection

Data were collected by three CHWs trained by the FWAF on Community-based Participatory Research and certified on the protection of human subjects by the Collaborative Institutional Training Initiative (CITI). They contacted, recruited, consented, and interviewed workers in public places (laundromats, churches, day cares, and parks), the FWAF offices, and workers' homes and workplaces.

CHWs used a convenience sample and administered the in-person survey to 132 parents. The sample design linked CHWs to outreach opportunities, therefore, there was a great discrepancy in the number of completed surveys per location (Quincy n = 52, Apopka n = 43, Immokalee n = 27). For instance, the CHW in Quincy had worked for many years in a laundromat. Through this job she had regular access to potential participants and time to complete the greatest number of interviews. In other locations, CHWs had to rely more heavily on reaching parents who were present in the FWAF offices for other reasons. Although there was an effort to recruit male parents, nearly all participants were women. Farmworkers who were not parents or whose children did not live with them were excluded from interviews.

Data entry and analysis

The project team utilized REDCap software to compile and analyze the data. The survey instrument was recreated in REDCap, and data were entered manually from the hard copies of the surveys. All team members performing data entry and analysis were CITI trained. REDCap allowed the team to compile data. For categorical variables, Fisher's Exact or Chi-square test was used to test for the association between each of the categorical survey questions and gender (male vs. female), formal childcare service (no vs. yes), location (Florida South, Central, and North), years worked (<10 vs. 10+ years), and specific occupations (nursery, vegetables, and mushrooms). For continuous variables (e.g., number of children), Wilcoxon or Kruskal–Wallis test was applied to comparing the difference in medians of each of the continuous variables according to gender, formal childcare service, location, years worked, and specific occupations. P-values were derived from the above-mentioned statistical tests and a P-value of < 0.05 was used to claim that there exists a statistically significant association or difference in median values. All data analyses were carried out using a commercially available statistical software package, SAS, version 9.4, English.

Results

Among the 132 farmworker parents who participated in the survey, 76% were female, 10% were male, and 12% were interviewed as a couple with shared children. Participants had worked in agriculture in the United States from 6 months to 20 years, with an average of 8 years. Farmworker parents had been working for the same employer for an average of 3 years. Participants had between one and eight children, and the average number of children for each participant was three. The majority of survey participants worked in nurseries, greenhouses, or vegetable-growing operations due to the locations where the in-person survey was administered (Table 1).

The overwhelming majority of participants (97.5%) reported someone else caring for their children while they were at work, and 97% of participants reported paying for this service. The majority of participants reported using informal and unlicensed childcare providers including babysitters (52.5%), family members (31.1%), neighbors (32%), and other (3.3%). Other responses included using established childcare services such as MSHS (6.6%). No parents reported using employer-provided childcare. Ninety-three percent of participants reported childcare as difficult or very difficult to obtain. Additionally, parents reported numerous barriers to enrolling their children in childcare (see Figure 2). Some of the most commonly cited challenges in obtaining childcare included eligibility criteria such as migration status and income requirements (54.9%); lack of available slots at the childcare center (20.5%); inability to complete the application for services due to language barriers (40.2%); inability to complete the application due to lack of Internet access (4.9%); and the child being ineligible for care due to age (22.1%). Some less commonly cited barriers included: being unable to use childcare services because the agency required parents to provide pay stubs, and some parents are paid only in cash (3.3%); the childcare agency required the child's social security number (0.8%); not being able to reach the childcare agency because of transportation barriers (3.3%);

Table 1. Participant occupation.

Occupation	Total participants	Percentage
Nursery or greenhouse	80	65.6
Vegetables	39	32.0
Mushrooms	12	9.8
Citrus or other tree fruits	1	0.8

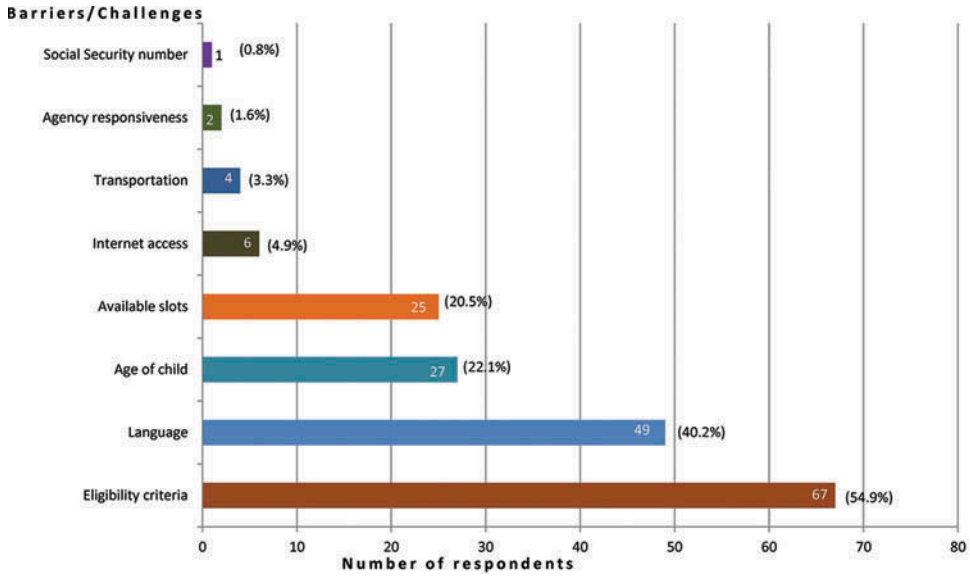

Figure 2. Barriers and challenges to accessing childcare.

and the childcare agency being unresponsive and not returning parents' calls regarding enrolling their child in care (1.6%).

In addition to challenges related to enrollment, the majority of parents (96.7%) noted challenges once their child was registered for and receiving care. Scheduling challenges were reported as a barrier for 84.4% of parents. This included the childcare agency closing before the work day was over or not opening early enough to accommodate the parents' work schedules. Holding mandatory parent meetings during work hours was also noted as a challenge. MSHS is required to hold periodic parent meetings, but the childcare centers are not required to hold meetings outside of regular work hours for farmworker parents. The survey did not inquire about how often participants were asked to attend parent meetings, but informal interviews with childcare providers indicated that parent meetings are typically held on a monthly basis. Transportation was reported as a barrier to accessing care by 38.5% of parents. Parents specified both not having means to transport their child to/from childcare services, as well as not being able to afford to pay for transportation.

Parents identified several ways in which childcare affects their workplace behavior; 63% reported having missed work or left work early due to childcare challenges in the past 2 months, and 97.5% reported having missed work for an entire day due to childcare issues in the past 6 months. On average, participants reported having missed an average of 4.7 days of work over the past 6 months. Two parents specified that they would only leave work early due to a childcare-related emergency.

Survey data indicate that most (97.5%) parents choose to miss work when childcare is unavailable, as opposed to bringing the children to work with them. No parents reported bringing their children to work with them if childcare was unavailable; 95% reported they felt bringing children to work would be dangerous. Additionally, parents identified various hazards that children could face in the workplace including exposure to machinery (67.2%); pesticides and chemicals (81.5%); slips, trips, and falls (66.4%); and sun and heat exposure (87.4%). Only 1.6% of participants felt that bringing children to the farm was not dangerous at all, and 1.6% felt that bringing children to the farm was only a little dangerous.

Parents were also surveyed on their perception of how concerned farm owners are about the safety of their employees' children. Results found 35.2% of parents believe that farm owners are very concerned about the safety of workers' children on farms, while 12.3% believe they are not at all concerned. Half of all parents surveyed reported that farm owners do not allow children to be present on farms while parents are working.

In the light of the agricultural labor shortage, the team was interested in better understanding what motivates farmworker parents to work in one area over another. Eighty-nine percent of parents reported that they are more likely to choose to work in an area with accessible childcare services (see Figure 3). Participants were presented with three scenarios and asked which they would choose: hourly pay of $10 and childcare is free (82%); hourly pay of $12 and you have to pay for childcare (13.1%); hourly pay of $15 and there is no childcare available (1.6%). Parents reported willingness to choose a job that offers less pay in exchange for free childcare services.

The project team compared responses among female and male participants. Significant findings are presented in Table 2. These groups reported different challenges in terms of accessing childcare. Among females, 78.5% of participants reported limited hours of operation among childcare providers to be a challenge, compared to 41.7% of men. Men also reported missing work due to childcare more frequently than females. Among male participants, 66.7% reported missing between one and three days of work each week, compared to 23% of females. More than half of all female participants (66%.7%) reported never missing work because childcare was unavailable, compared to only 33.3% of men who reported never missing work due to childcare.

The project team also explored the most effective strategies for communicating with farmworker parents due to a request for this information from employer stakeholders. Table 3 compares data from individuals who have worked in agriculture for fewer than 10 years vs. 10 or more years. Among those who have worked in agriculture for

Table 2. Comparisons by gender.

	Male No. (%)	Female No. (%)	*P*-value
Informal childcare service			
No	9 (75)	92 (98.9)	.0044
Yes	3 (25)	1 (11.1)	
Years worked in agriculture in the United States			
N	12	90	
Mean	5.25	7.76	
Standard deviation	5.53	4.80	
Median	3.5	8	0.0554
Range	1–18	0.5–19	
What challenges related to childcare have you faced in the last two months?			
Hours of operation			0.0114
No	7 (58.3)	20 (21.5)	
Yes	5 (41.7)	73 (78.5)	
No transportation			0.0260
No	3 (25.0)	58 (62.4)	
Yes	9 (75.0)	35 (37.6)	
How often do you leave work early because you do not have childcare for your children?			
2–3 days a week	3 (25.0)	7 (8.1)	0.0148
1 day a week	5 (41.7)	13 (14.9)	
Never	4 (33.3)	58 (66.7)	
Other	0 (0)	9 (10.3)	
How many days of work have you missed in the last six months because of childcare?			
N	10	76	
Mean	8.2	4.33	
Standard deviation	5.41	4.49	
Median	8	3	0.0103
Range	0–18	0–30	

Note: *P*-value was derived from Fisher's Exact test.

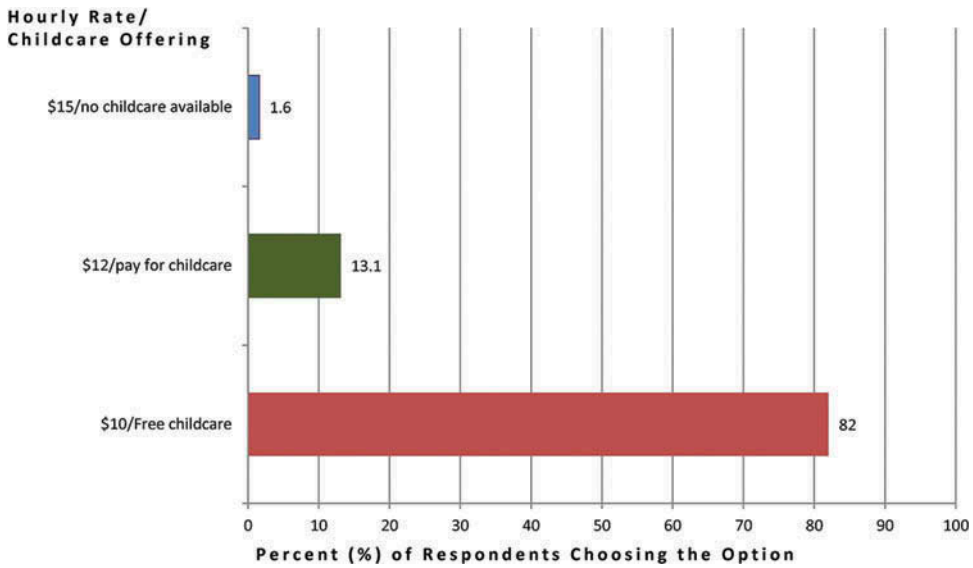

Figure 3. Employment preference based on childcare offerings and hourly rate.

Table 3. Comparisons by years worked in agriculture (<10 vs. ≥10).

	< 10 No. (%)	≥ 10 No. (%)	*P*-value
Do you have access to … ?			<0.0001[a]
Cell phone			
No	7 (10.6)	27 (52.9)	
Yes	59 (89.4)	24 (47.1)	
Text messaging			<0.0001[a]
No	25 (37.9)	46 (90.2)	
Yes	41 (62.1)	5 (9.8)	
Email			0.0032[a]
No	53 (80.3)	50 (98.0)	
Yes	13 (19.7)	1 (2.0)	
Bulletin			<0.0001[a]
No	50 (75.8)	18 (35.3)	
Yes	16 (19.7)	33 (64.7)	
Best way to be reached regarding childcare			
Phone			<0.0001[a]
No	12 (18.2)	33 (64.7)	
Yes	54 (81.8)	18 (35.3)	
Text messaging			0.0674[a]
No	61 (92.4)	51 (100)	
Yes	5 (7.6)	0 (0)	
Email			0.1354[a]
No	60 (92.4)	50 (98.0)	
Yes	6 (9.1)	1 (2.1)	
Bulletin			<0.0001[a]
No	62 (93.9)	32 (62.8)	
Yes	4 (6.1)	19 (37.2)	
Other			1.0000[a]
No	62 (93.9)	48 (94.1)	
Yes	4 (6.1)	19 (37.2)	
Years working with current company			
N	63	47	
Mean	1.93	5.01	
Standard deviation	1.63	2.40	
Median	1	5	<0.0001[b]
Range	0.3–7	1–10	

[a]*P*-value was derived from Fisher's Exact test.
[b]*P*-value was derived from Wilcoxon Rank Sum test.

10 or more years, 47.1% have access to a cell phone, 9.8% can receive text messages, and 2% can receive emails. In comparison, 89.4% of participants who have worked less than 10 years have cell phones, 62.1% can receive text messages, and 19.7% can receive emails. Those who have worked in agriculture for 10 or more years were more likely to report having access to a work bulletin and were also more likely to choose the work bulletin as their preferred method of communication. Participants who have worked in agriculture for 10 or more years reported an average of 5.01 years working for the same grower, whereas participants working in agriculture for less than 10 years reported working with the same employer for an average of 1.93 years.

Discussion

Keeping children away from the agricultural worksite is an important safety practice. Farmworker parents in our study overwhelmingly reported that they do not bring their children to work. When childcare is unavailable, nearly all reported missing work as opposed to bringing children to work with them. This is an interesting finding that contradicts anecdotal information gleaned from our focus group, site visits, advisors, and stakeholders. This practice may vary regionally and by employer and warrants further investigation. Given the conflicting information received from interviews versus focus group and site visit data, we believe the survey data may have been affected by social acceptability bias; CHWs administering the survey are known as health educators who promote safe and healthy practices among the farmworker community. Parents may have anticipated that the CHWs would not approve of bringing children to the worksite, and therefore, they reported not doing so.

Lack of childcare universally can impact an employee's ability to work, rates of absenteeism and tardiness, and concentration at work.[10] The implications for agriculture are potentially even more impactful given the time sensitive nature of this industry due to growing seasons. Participants overwhelmingly reported they choose work locations based on the availability of childcare services, and that they would be willing to accept lower wages if childcare was provided as part of the employee benefits package. This issue becomes increasingly important as more women participate in the agricultural workforce. Providing formal childcare improves female market participation and can even facilitate the social inclusion of children from disadvantaged backgrounds, especially migrants.[11–14]

These findings offer agribusiness leaders important data to consider and suggest industry support of childcare as an important workforce investment. According to agribusiness leaders and the project's expert advisors, a national labor shortage is a major concern among growers in the United States. In fact, current reports indicate that growers have begun to offer increased wages and augmented benefits packages to attract labor to their farms.[10] Findings from this study indicate that high quality and affordable off-farm childcare

services could serve as a means to attract farmworkers to regions currently experiencing a labor shortage; earlier, it was noted that 82% of participants indicated that they would choose to earn a $10 hourly wage and receive free childcare as opposed to 13.1% who would prefer to receive a $12 hourly wage and pay for childcare. Only 1.6% would choose an hourly wage of $15 if no childcare were available. To put this data in context, hourly workers earn an average hourly wage of $9.71 and those receiving piece-rate wages earn $11.57 per hour.[3]

Additionally, agribusiness leaders have indicated a desire to increase employee retention and productivity with particular interest in growing the number of women in the agricultural workforce.[15,16] Findings show that among farmworker parents who have worked in agriculture for greater than 10 years, the mean length of time under one employer is 5.01 years, compared to only 1.93 years among employees with less than 10 years of experience in agriculture. This indicates that farmworkers can and do choose to return to the same farms each year. Data also indicate that farmworker parents would miss less work if childcare services were readily and consistently available. Findings also suggest that childcare providers could better serve agricultural worker parents by addressing challenges such as transportation, hours of operation, and language barriers, among others.

Data show that there are differences in communication preference among farmworkers with ≥10 years of experience in agriculture compared to those with <10 years of experience. The project team suspects these differences are related to age. Farmworker parents with less work experience were more likely to utilize text messaging and email communication in comparison with the more experienced group. This is an important finding for agricultural employers and childcare providers who are interested in reaching a broad range of farmworker parents.

Study findings suggest key areas of focus in the context of a socio-ecological approach to impacting child safety. (1) Parents have the ability to make decisions about childcare and the safe practices they encourage and promote within the family unit. Parents also can choose employment in areas where off-farm childcare is available. (2) Childcare providers are able to adapt their services to maximize convenience and be culturally appropriate for farmworker parents. These accommodations may include offering hours that accommodate farm work or hosting mandatory parent meetings at times that are convenient for parents working in agriculture, such as on weekends or rainy days. Additionally, childcare providers can make a concerted effort to recruit and provide outreach on farms. Providing additional support to help parents navigate eligibility criteria and the application process is another way that childcare providers can foster the utilization of their services by farmworker parents. (3) The role of individual growers in the SEM is to create a culture of safety on the farm. This culture of safety can include a commitment to supporting off-farm childcare services that ensure children are engaged in safe, developmentally appropriate care, which in turn prevents parents from being distracted by the needs of their child while at work. A culture of safety includes encouraging parents to seek off-farm childcare options and facilitating this process as much as possible. For instance, employers could allow local childcare providers to host recruitment events on farm property or support childcare providers in other ways such as providing transportation services or financial support. (4) Agribusiness leaders can play an important role in advocating for the safety of employees' children on farms and generate efforts to make safety a priority for the national coalitions of growers. Voicing support at the national level can bolster support among growers. Agribusiness leaders also have the opportunity to provide training and technical assistance to growers related to providing and supporting childcare options for employees. (5) National childcare organizations can provide support to their local offices and model best practices for serving the children of farmworker parents. These leaders can encourage childcare providers to adopt practices that are convenient for both parents and growers, as well as practices that foster a positive and communicative relationship among the local childcare providers and growers.

Limitations

Collecting data from a random sample of migrating farmworker populations for any type of research is a challenge. The shifting

demographics of the target audience present numerous challenges when it comes to understanding the diverse population of farmworkers in the United States. These challenges include increased women in the workforce, more families settling in areas, and changing trends in immigration. Participants for this study comprised a convenience sample. Farmworker parents, many of whom have undocumented immigration status, are often wary to discuss personal issues with researchers; therefore, having CHWs administer the survey allowed the survey team better access among parents. While CHWs' trusted place in the community overcame some barriers to reaching the migrant population, their knowledge of and connection to individuals in the research population made random selection highly unlikely. As a result, the project team assumes some selection bias in the survey results.

Another limitation of this in-person survey is that the majority of participants were female or answering as part of a couple. Only 9.8% of participants were male and this may not accurately represent migrant parents in the United States. Survey administrators reported that males were less willing to participate, which may be due to heightened fear related to immigration status or because of males' perceived roles in the family. Findings in Table 2 may not represent male farmworkers well due to the small sample size.

The project team was not able to administer the in-person survey nationally, which may impact the findings' generalizability. While the project team made efforts to administer the survey in three distinct regions of Florida with diverse types of agriculture and varying levels of access to childcare services, we recognize that these data are limited to farmworker parents in Florida and may not represent trends nationwide. Findings from the three locations were compared and some significant differences were found; however, these findings were not relevant to the purposes of this paper and were omitted. This information may be useful for Florida agricultural employers and the team plans to make this information available to relevant stakeholders.

The project team also recognizes that the farmworker parents who participated in the initial focus group that led to the development of the in-person survey are associated with MSHS and are not from the same population of farmworker parents among whom the survey was administered, who are more likely to utilize informal childcare services. The project team did compare findings from these two groups and found some differences, but did not feel these findings were relevant to this paper, in part due to the small sample size of participants utilizing formal childcare services. The team recommends further investigation among a true random sample to explore this issue.

Conclusion

Protecting children of migrant farmworkers from the hazards on the farm worksite is extremely important. Despite the availability of family and childcare services, challenges persist for these families in terms of accessing and using childcare services. In addition to programmatic approaches to mitigate some of these barriers to childcares, additional research is needed. The authors recommend further investigation to explore the expanding role of women in agriculture and how this impacts the need for childcare, the regionally specific challenges related to childcare for migrant families, and the role growers and other agribusiness leaders can play in childcare. We recommend this type of research be replicated in other areas of the country among farmworker parents working in a variety of types of agriculture. We also recommend fostering broader partnerships among parents, childcare providers, and growers in order to address the needs identified in this study and develop a plan for communication to better address future challenges in a proactive and timely manner.

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BRIEF REPORT

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Integrating Agricultural Injury Prevention with Rural Pediatrics: A Pilot Assessment

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ABSTRACT

Background: Childhood agricultural injuries are an important public health problem. Pediatricians are a trusted source of expertise in children's health and safety and could serve as a sphere of influence to augment child agricultural injury prevention efforts. The purpose of this pilot study was to begin to explore the perspectives of pediatricians in a large rural health clinic about addressing child agricultural injury prevention within their practice. Methods: Structured interviews were conducted with nine pediatricians who maintain a clinical practice of at least 2 days a week and care for newborns through adolescents. Detailed interviewer notes were reviewed and summarized. Results: Rural pediatricians readily acknowledge substantial numbers of farm children in their practice. In general, these providers: (1) recognize farming environments as a safety risk and see agricultural injury prevention as an important topic to be addressed with their patients, (2) are comfortable discussing the topic, but seldom actually initiate such conversations, and (3) doubt farm parents would be receptive to integrating agricultural injury prevention into a rural pediatric practice. Conclusion: While rural pediatricians recognize child safety risks in farm environments, they are reluctant to actually initiate this conversation with parents. Future research should explore both pediatricians' hesitancy to discuss agricultural injury prevention and farm parents' readiness for integrating the topic into pediatric primary care visits. Such would help to assess the viability of pediatricians as a sphere of influence for augmenting child agricultural injury prevention efforts.

KEYWORDS

Child agricultural injury; farm environment safety/risk; rural pediatrics; socio-ecological model; sphere of influence

Introduction

Childhood agricultural injuries represent an important public health problem. Every day 33 children sustain nonfatal agricultural injuries serious enough to require medical attention, and every 3 days a child dies from an agricultural injury.[1] The overall numbers of nonfatal farm injuries have declined since 2001,[1] but the fatality rate for workers younger than 16 years in agriculture remains consistently higher than the rate for workers younger than 16 years in all nonagricultural injuries combined.[1,2] Farm worksite exposures that lead to these injuries and fatalities include tractors, other vehicles (all-terrain vehicles, skidsteers), farm machinery, large animals, unguarded heights, and water sources.[1–3] National efforts to address these injuries and fatalities have increased in the past 10–20 years and have led to the development and implementation of injury prevention initiatives across the United States.[2,4] Still, the problem of childhood agricultural injuries persists.

The socio-ecological model provides a framework to examine childhood agricultural injury prevention initiatives and illustrates the spheres of influence (adult, interpersonal, community, institution/organization, policy) that could potentially impact the protection of children from agricultural hazards.[5] The socio-ecological model is centered on the idea that there are multiple spheres of influence, with a continuum of strategies that impact health behaviors, and that multilevel interventions are the most effective in changing behaviors.[6] A recent review of child agricultural injury prevention initiatives found the

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majority focused on the individual level of the socio-ecological model; that is educating children themselves about farm safety.[4] Based on the tenets of the socio-ecological model,[2] there is a need to look at spheres of influence beyond just the child if we hope to address the persistent problem of child agricultural injuries and the limited success of prevention efforts.

Pediatricians are trusted sources of information and expertise on children's health and safety. Given that trust and expertise, pediatricians could serve as spheres of influence to augment child agricultural injury prevention efforts. In fact, the American Academy of Pediatrics policy statement on agricultural injury prevention provides recommendations for pediatricians who care for children living or visiting on farms.[7] Furthermore, families have regular contact with pediatricians for both routine care and acute medical needs, and parents rely on clinicians for advice on child health and general injury prevention.[8] Ongoing success of integrating behavioral health services into rural pediatric primary care in health systems across the country[9,10] led us to consider whether rural pediatric primary care could also serve as a potential venue for child agricultural injury prevention advice and guidance. Thus, the purpose of this study was to begin to explore perspectives of pediatricians in a large rural clinic about addressing agricultural injury prevention within their practice. Our goal was to identify potential ways agricultural injury prevention could be effectively introduced and integrated within pediatric clinical practice.

Methods

Participants

Primary care pediatricians in a rural Midwestern medical center were invited to participate in individual interviews that sought to assess perceptions about addressing agricultural injury prevention in their medical practice. The study protocol was approved by the Marshfield Clinic Research Institute Institutional Review Board and the Chair of the Department of Pediatrics.

All nine pediatricians who maintain a clinical practice of at least 2 days a week and care for newborns through adolescents participated in the study. Providers who solely work with adolescents or work in a pediatric specialty (e.g., cardiology, endocrinology) were not asked to participate.

Measures

A structured interview tool consisting of seven questions was constructed by the authors. Prompts were included to elicit additional context for the responses. Questions focused on establishing how frequently pediatricians care for patients who live, work, or play on a farm, whether they view farm exposures as a safety risk, and how or if they address agricultural injury prevention during routine medical visits. The structured interview tool was pilot tested with two, third-year pediatric residents and then revised.

Procedure

Pediatricians were contacted by e-mail or in person and provided information about the purpose of the study. Each interview took place in the pediatrician's office. At each interview, the pediatrician received a copy of the Research Participant Information Sheet to review; each verbally consented to participate. The first author conducted the interviews. Interviewees were also provided the chance to provide closing thoughts and reflections. The interviewer did not deviate from the script, except in one instance where a nurse entered the room and the provider invited the nurse's perspective. The interviewer took detailed notes of pediatricians' responses and typed her notes immediately following each interview.

Data analysis

The interviewer's notes were reviewed question by question. Responses to closed-ended questions were tallied, and interviewer notes were reviewed to provide more detail about pediatricians' responses. Results were discussed at project meetings and reflected upon by all study team members. A trained qualitative data analyst reported and summarized the results.

Results

The nine rural pediatricians reported commonly seeing children who live, work, or play on farms. They estimate 10–30% of their pediatric practice comprises such children. Two pediatricians noted this percentage would be even higher if the number of child visitors to farms was included, and in retrospect, some estimates should have been clarified and revised upward to include all children with farm exposures. Generally, pediatricians felt exposure to farming environments posed a safety risk that should be addressed with their patients.

The majority reported that farm parents never ask about safety risks associated with farming environments. Two providers stated they are rarely asked, but if they are it is usually in relation to a family debate about age appropriateness of a certain farm activity or a nonfarm parent's concerns about a child visiting a relative on a farm.

No pediatricians reported asking about children's exposure to farm environments on a regular basis. Responses ranged from "no, never" to "occasionally". The topic might come up if the provider asks about the parents' employment or the child's daycare arrangements. Although the majority of pediatricians did not address agricultural injury prevention with their patient populations, they reported they were, in fact, quite comfortable discussing the topic. Yet, few of the providers reported any actual experience in farm environments.

Despite being comfortable talking about agricultural injury prevention, pediatricians seemed reluctant to raise the issue and felt farm parents would not be receptive. Some providers stated many farm parents do not think anything is wrong with what they are doing, so agricultural injury prevention would be a "hard sell" as one pediatrician phrased it. Overall, pediatricians were skeptical that agricultural injury prevention introduced in a pediatric setting would be effective or that families would listen and buy-in.

Discussion

The main findings from this pilot study were as follows. Rural pediatricians readily identify a significant number of farm children in their practice. They recognize the farming environment as a safety risk and see agricultural injury prevention as an important topic for their patients. Pediatricians feel comfortable discussing the topic, but few actually initiate such conversation. They doubt that farm parents would be receptive to integrating agricultural injury prevention into a rural pediatric practice.

A mix of factors has been identified as determinants of general injury prevention counseling in pediatric practices.[8] Some of these factors include the physician's: (1) belief about the importance of the topic, (2) confidence in their ability to counsel on the topic, (3) perceptions about the effectiveness of counseling, and (4) office time constraints.[8] Pediatricians in our study identified agricultural injury prevention as an important topic that they were comfortable addressing, but they had concerns about the effectiveness of the counseling. The pediatricians did not mention office time constraints as a barrier to agricultural injury prevention counseling, but believed that time constraints were a barrier for parents. Based on these factors, it appears that pediatricians' hesitancy to address agricultural injury prevention in our study is based on perceptions they hold about farm parents, which are untested, since they do not address the topic on a regular basis. It is not clear *why* pediatricians suspect a negative reaction from farm parents. The structured interview instrument utilized here was not designed to explore this disconnect. However, future research should explore more deeply providers' reluctance to discuss agricultural injury prevention, as well as farm parents' readiness for integrating the topic into pediatric primary care visits.

The reflections gleaned from interviewer notes suggest a more nuanced view to the socio-ecological model. Farm parents have their own socio-ecological spheres ranging from friends and family, organizations to which they belong, the wider rural community, to the policy and social factors impacting their lives. Indeed, physicians have their own unique socio-ecological spheres in which they must practice. From their coworkers, the rules and policies of their employer or private practice, and their wider community of fellow practitioners, to the laws, ethics, and wider culture of medicine that direct their decisions and action, physicians exist in their own milieu.

The idea that everyone does not exist in the same socio-ecological model becomes clearer in light of pediatricians' hesitancy in addressing agricultural injury prevention. Interviewer notes referenced that providers more routinely covered topics of well-sourced water, unpasteurized milk, gastroenteritis, or salmonella, which are more typically addressed within biomedical settings with a clear cause–effect relationship and with clear preventive measures and/or medicines to be prescribed as cures. In contrast, child agricultural injury prevention is a broad topic covering an array of potential hazards with no simple or straightforward prescriptions for prevention or cure. Thus, pediatricians may not see agricultural injury prevention fitting into the biomedical model, and this may explain some of the hesitancy on the part of pediatricians to incorporate the topic into their practice. Indeed, in a recent survey regarding all-terrain vehicle anticipatory guidance practices with children, the most common barrier identified by primary care providers for not addressing all-terrain vehicle injury prevention was that it was not a routine part of their practice.[11] Approaching farm safety interventions from the perspective of unique, nuanced socio-ecological spheres could prove fruitful and could reveal avenues for agricultural injury prevention to penetrate pediatric primary care. Such a goal requires further investigation, as the current study has several limitations. The study included a single medical center and nine rural pediatricians. Interviews were structured, limiting the depth of the data that could be elicited. Interviews were not recorded and transcribed, so an in-depth analysis into common themes is not possible due to the lack of full, exact quotes.

Conclusion

Rural pediatricians recognize that exposure to farm environments poses a safety risk that should be addressed, but they are reluctant to do so and are uncertain of parents' receptivity to such information. Researchers should recognize the plurality of socio-ecological frameworks present in the life of a single individual (for example, as she/he moves from farmer to parent) and between individuals (such as a parent and a pediatrician). Physician's hesitation to address agricultural injury prevention is perhaps not surprising given the complexity of these competing frameworks.

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A Case History Introducing the Oregon Ag Seminar Series—Keys to Program and Research-to-Practice Success

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PRACTICE/CASE HISTORY

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A Case History Introducing the Oregon Ag Seminar Series—Keys to Program and Research-to-Practice Success

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ABSTRACT
This case history of Oregon state's Ag Seminar Series is consistent with the Socio-Ecological Model, demonstrating how policy at a state level can influence an organizational approach with impacts that ultimately influence safety practices on the farm. From modest beginnings, the Ag Seminar Series, offered through a workers compensation insurance company, now serves over 2,300 Oregon farmers annually in English and Spanish. This case offers unique but also replicable methods for educators, insurers, and researchers in safety education, safety motivators, and research-to-practice (r2p).

KEYWORDS
Education; insurance; partnership; r2p; safety culture

Introduction

The reasons safety education and new safety measures often take low priority on the farm are multifaceted. We understand from farmers that this low priority is often the unintentional result of farming's daily competing priorities. Other reasons include a lack of risk awareness, lack of support, or a regulatory mandate. This paper introduces a model program and a chain of events that has broken these barriers for farmers and safety professionals in Oregon state, the Ag Seminar Series of the State Accident Insurance Fund (SAIF) Corporation. SAIF Corporation is a not-for-profit, state-chartered workers' compensation company with a long history of serving Oregon's farm community.

With a diverse climate and geology, Oregon is a major contributor to our nation's food supply. Workforce estimates are 58,020 farm operators[1] and 90,289 migrant and seasonal farmworkers.[2] Cattle and calf production is a top commodity for both beef and milk production. Other leading crops include hay, gains, greenhouse and nursery stock, azaleas, Christmas trees, ryegrass, clover, and sugar beet seeds. Oregon also ranks number one nationally for production of several types of berries, hazelnuts, and onions, and it is in the top four states for production of peppermint, cherries, hops, crab, garlic, pears, mink, cranberries, and wine grapes.[1]

Using the socio-ecological model, commitment toward safety takes place at every level of influence: policy, institutional, community, interpersonal, and with the grower/farm family. The SAIF Ag Seminar Series is a prime example of this model. This is seen in the growth of the program, retention of membership, and in follow-up consultations that reveal striking evidence of growers taking up safety solutions.

Model institutional structure

"SAIF will be an industry innovator that makes Oregon the safest place to work. We exist to serve and protect the Oregon workforce, meeting the needs of workers and employers and strengthening Oregon's economy" is the vision statement for SAIF Insurance Corporation, and a good reflection of their Ag Seminar Series.

The Ag Seminar Series began in 1996 after House Bill 3019 Agricultural Employer Inspection Exemptions (sponsored by the Oregon Wheat Growers league) passed, establishing an

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exemption for small farms (10 or fewer employees) from random inspections under the Oregon-Occupational Safety and Health Act (OR-OSHA). (Farms are not exempt from inspections driven by a complaint or a serious accident.) This exemption is granted with four conditions, one of which is that the farm must attend 4 hours of safety training annually. The workers' compensation insurance business was competitive, so SAIF offered the 4-hour classes with the intent to improve safety outcomes and distinguish themselves in service to the agricultural marketplace.

Since 1995, thousands of farm owners, managers, and workers have attended SAIF's agricultural safety seminars, learning how to be safe in one of the most hazardous occupations. Today, these free, half-day seminars are held in 16 cities across the state and are available to anyone, regardless whether or not insured through SAIF Corporation. In 2004, trainings were added entirely in Spanish and now are offered in nine cities. The program has seen steady enrollment growth from their start in 1995 serving a few hundred people to over 2,400 in 2015 (including 678 Spanish participants). Today, the program reaches approximately 90% of insured farms in Oregon.

While the history of the Ag Seminar Series (Figure 1) may be unique to Oregon, the political and safety climate is not much different from other Western populist states. Originally, the program launched as a necessity, but its growth and success built on its positive reputation and grassroots support. An Oregon grass seed grower commented on the Ag Seminars, "Before the seminars, I didn't know where to start. The printed rules and recommendations just seemed overwhelming, so we really didn't do much. The seminars break it down, help me know where to start and what to do next, and give me the information I need to make changes at our farm. We approach our work totally differently now."

This is an example of a state program with a spirit of service and continuous quality improvement. Key lessons from its 20-year history for organization development include:

- Top-down commitment/investment
- Incentives to participate (exemption from random compliance visits from OR-OSHA)
- Content expertise provided by SAIF Corporation internal review board
- Integrated services of insurance, claims management, education, and consultation
- A program informed by needs and requests from policy holders (from evaluation forms)

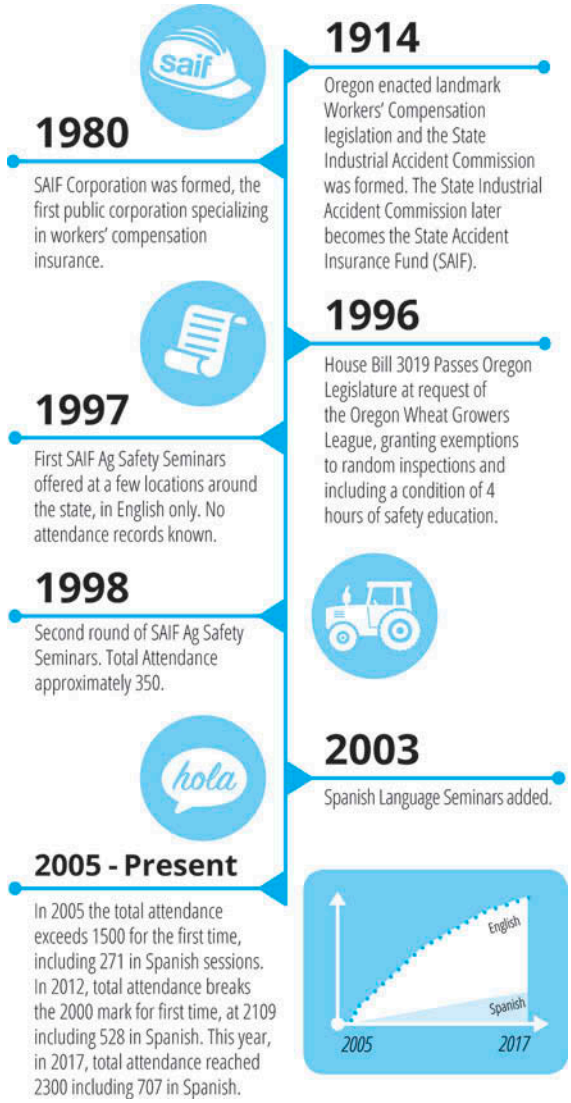

Figure 1. SAIF Corporation Ag Seminar Series timeline.

Ag safety education methods

The qualities of the educator are a known factor for a successful education program—their knowledge, credibility, and charisma. Five trainers work

as a team in developing and peer-reviewing the curriculum. Trainers each have backgrounds that foster trust and credibility with a mix of education and direct farming experience—and they ensure their audience knows this by drawing on examples and storytelling in their own personal narrative.

Quality of content and delivery

Each year, the SAIF Ag Seminar team focuses on "doing a few things well." The Ag Seminars offer only a four to five topic program each year, but with a strong formative development approach and with a newly crafted program every year. The content and delivery requires 9 months of development and is well rehearsed and vetted before the new season. For example, in 2016–2017, the topics are Learning to S.I.T. (a three-step approach to make training more effective.); Clearing the air on pesticide safety; Farm shop safety: improving your odds; Welding safety and other hot topics.

Engagement methods are integrated throughout the session. These include the use of TurningPoint® Audience Response Surveys (audience members can vote with "clickers" and see live results), demos of equipment at breaks, use of adult education methods, breakout discussion groups, and surveys. The last essential feature is the follow-through on the seminars with voluntary consultations and educational resources (website, videos, and handouts.)

Many first-time attendees express something to the effect of "it wasn't nearly as bad as I expected," which one may not seem high praise, but it is if you know the audience. As one SAIF educator expressed, "If the grower is heading home to make some changes and attends the seminar again next year, that veiled compliment feels like pretty high praise. And that happens all the time."

Adoption motivators

SAIF educators rely on three motivating messages for the Ag safety educator's toolbox—*The People, the Money, and the Law*.

The People: A personal human impact story is a powerful motivator. It is memorable and engaging and presents information in a real-life context. Storytelling's value lies in its ability to draw in the learner, persuade him or her of the message, and generate action.[3] Recently, the technique has gained acceptance as an effective method for communicating safety information for a variety of agricultural and worker audiences.[4,5]

The Money: Audiences want to know the costs/benefits associated with recommendations—costs of injury, the cost of the equipment, and implementation time.[6] SAIF educators provide quick reference sheets with costs and vendors to make a business case and help make the first step to implementation.

The Law: Legal requirements with local enforcement carry weight. There is strong evidence that focused inspection programs with penalties result in decreases in injuries. There is uncertainty at the effectiveness of consultation and awareness programs to prevent injuries over the long term.[7–10]

When introducing safety solutions, these three strategies are keys to adoption on the farm. During farm consultations in the months after the seminars, growers often show excitement in showcasing their changes. These have included safety measures such as retrofitting a roll-over protection system (ROPS) on an older tractor, building an upgraded chemical storage facility, purchasing personal protective equipment (PPE), and handling techniques. Sometimes, there are very large capital purchases being made, such as replacing traditional all-terrain vehicles (ATVs) with side-by-side farm utility machines. However, most often reported are changes to the culture of safety, comments like "now we know how to talk to each other on our farm" and "now the owners and the employees really work together on improving safety." People have been willing to change, when they have the resources and motivation.

Partner in research-to-practice

Unique to the Northwest is the Ag Seminar's comprehensive reach, quality of content, and relationship of trust with growers. These are essential qualities in a partner for dissemination of new findings and innovative solutions. SAIF leaders have embraced this role and regularly review new releases and best practices. Here are several

examples of their research-to-practice efforts with two NIOSH Agricultural Safety and Health Centers:

Example: Practical solutions for pesticide safety

A SAIF educator saw the Pacific Northwest Agricultural Safety and Health (PNASH) Center's Practical Solution for Pesticides Safety guide and called it "As good as gold." SAIF then collaborated with PNASH to develop a program for the season's Ag Seminar Series and supported the printing and distribution of 2,000 copies of the guide. See http://deohs.washington.edu/pnash/practical_solutions.

Example: Universal PTO shield

SAIF saw the great potential of the universal power take-off (PTO) shield that was brought to their attention by a farmer. It is a low-cost and effective option that is being promoted and evaluated by the New York Center for Agricultural Medicine and Health. See http://www.nycamh.org/programs/ptoshield.

SAIF is not only a willing partner but active in outreach to innovators to identify new information and solutions for their clients. Their presentations integrate scientific literature and also introduce their experts/innovators to the audience—adding an additional human element to the story of the research.

Conclusions

SAIF's Ag Seminar Series offers a model for quality safety education through their iterative formative development of the content and program, integration of research and new solutions, and an engaged commitment from stakeholders.

Future program development and replication of their program could be informed through an enhanced evaluation of methods, knowledge gain, up-take of recommended practices, and needs assessments. Yet what we know is that the growth of the program and audience reviews speaks to a highly successful program.

The SAIF Ag team is currently exploring several new directions. One is a tractor ROPS Rebate Program, which would make it the first Western state to launch this program (first developed and organized by the Northeast NIOSH Agricultural Center, NYCAHM). Recently, the program has partnered with Future Farmers of America (FFA) and integrated further youth safety education. For example, in the last year, the seminar promoted ATV safety, producing a personal narrative video with an FFA state officer who lost her nephew to an ATV crash.

This case history of SAIF Corporation's Ag Seminar Series is consistent with the Socio-ecological Model, demonstrating how policy at a state level can influence an organizational approach with impacts that ultimately influence safety practices on the farm. The program offers unique but also replicable methods that foster broad-based engagement and commitment. A tagline on their agricultural website says it all: "Be a leader—Creating an injury-free workplace takes everyone working together in a positive and supportive environment."

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"Keep Me Doing What I Love": A Photovoice Evaluation of the Missouri AgrAbility Project

Rebecca Mott, Kimberly Keller & Karen Funkenbusch

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"Keep Me Doing What I Love": A Photovoice Evaluation of the Missouri AgrAbility Project

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ABSTRACT

The Missouri AgrAbility program links the Cooperative Extension Service at a land-grant university with a nonprofit disability organization to provide practical education and assistance that promotes rural independence. This project utilized Photovoice to describe how Missouri AgrAbility clients perceived how the program impacts their lives. This article relates clients' perceptions of the impact of the AgrAbility program on their lives to the socio-ecologic model framework. Although the primary focus of AgrAbility is to help individuals who have disabilities maintain their independence, all levels of the socio-ecological model are integral in meeting the needs of program participants.

KEYWORDS

AgrAbility; evaluation; Extension; Photovoice; socio-ecological model

Introduction

Learning to live with a disability can be a significant transition, and many individuals struggle with the challenge of examining how the disability will affect who they are and what their role is in the society.[1,2] Disabilities and health concerns can create unique challenges for farmers and ranchers, who may be unable to separate their personal identity, family life, and agricultural business. For those whose identities are tied with farming and ranching, disabilities, disease, and health challenges threaten not only vocation, but also personal identity and family function. Farmers with disabilities place great value on continued engagement in the farm environment.[3]

This study describes clients' views of how the Missouri AgrAbility program impacted their lives. Examining the interactions that occur in the individual, social, community, organizational, and public policy layers of the socio-ecological model can help researchers, service providers, and policymakers understand the complexity that surrounds disability, disease, and chronic health conditions in the context of agriculture. Ultimately, the clients participating in this evaluation will help Missouri AgrAbility staff to understand the program on a deeper level, consider how all the layers of the socio-ecological model are reflected in the experiences of AgrAbility clients, and ultimately, improve program effectiveness.

Program description

The Missouri AgrAbility program links the Cooperative Extension Service at a land-grant university with a nonprofit disability organization to provide practical education and assistance that promotes rural independence. Congress authorized the AgrAbility Project in the 1990 Farm Bill and the National Institute of Food and Agriculture, an agency of the U.S. Department of Agriculture, administers the AgrAbility Project.[4]

In Missouri, the AgrAbility partnership includes members from the University of Missouri Extension, Lincoln University Cooperative Extension, and the Brain Injury Association of Missouri, Inc. The partnering organizations provide educational workshops, off-site visits, on-site farmstead assessments, technical recommendations, and resource materials to farmers, ranchers, farm workers, and family members who are limited by any type

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of physical, cognitive, illness-related disability, or chronic health conditions. Additional partners are contacted to provide services to clients as needs surface during the assessment process.[5] In 2016, Missouri AgrAbility worked with 30 individual farmers and ranchers who had diseases, disabilities, and/or chronic health conditions. The ultimate goal of the program is to promote the return of these individuals to the farm, their community, and independent living.

Need for evaluation

The Missouri AgrAbility program utilizes the McGill Pre- and Post-Quality of Life surveys to evaluate program outcomes. However, AgrAbility staff desired to add a deeper, richer, qualitative layer to their evaluation process to better understand how the program was impacting the lives of their clients. A natural fit for this project, qualitative research is a situated activity that locates the observer in the world of the participant.[6] This type of research activity seeks to understand the meaning people have constructed; that is, how people make sense of their world and the experiences they have in the world.[7]

Methods

We used PhotoVoice as a tool for this formative, qualitative evaluation. PhotoVoice is a participatory action research process that allows participants to tell a story through the use of pictures.[8] This method provided the opportunity to see the Missouri AgrAbility program through the eyes of its clients, read their written words describing their photographs, and listen to how they believed the AgrAbility program impacted their lives. Pictures, combined with written and spoken language, are a powerful communication tool that allows for more richness and depth than traditional survey methods.[8] The benefit of this type of evaluation is that it allows one to hear the voices of participants, identify program strengths, and even discover unintended program outcomes.[9] Additionally, the variety of methods included in the PhotoVoice methodology provides triangulated data, which strengthens the ability to analyze and draw conclusions from the data.

Seven clients were recruited for this project upon consultation with the AgrAbility Program Director. Key considerations were engagement with the program, client availability, and including maximum variation in views and perspectives among clients. Ultimately, three AgrAbility clients consented to participate in the evaluation study. We do know that one of the seven clients who were recruited was out of state on a summer job, but it is not clear why the other clients chose not to participate. Informed consent was obtained from all study participants. Research was reviewed by the Institutional Review Board and approval was obtained.

Of the three consenting clients, two fully participated by sending pictures with captions and participating in a phone interview. The third, who was the newest to the AgrAbility program, requested to participate in the phone interview portion of the evaluation only. Although it is not known why the third client did not participate in the photography component of the project, we do know that this client was the most recently disabled and was currently undergoing treatment for cancer.

Although three clients is a small number, the aim of qualitative studies is not to be representative of the population. Rather, insight and meaning shared by each of these unique AgrAbility clients provides the program with information that can help provide insight to inform program improvement.

To begin the project, the three consenting AgrAbility clients were invited to use their own device to take pictures that show how the Missouri AgrAbility program impacted their lives. They were then invited to choose one to three of their favorite photos and write captions of 50 words or less that described the picture. Clients emailed the pictures and captions to the researcher, who then contacted the client via email to set up a time for a phone interview.

Semi-structured phone interviews with each participant lasted from 15 to 30 minutes, and the evaluator took notes during this process. Phone interviews were not recorded in hopes of helping participants feel more comfortable during the interview process. An adapted SHOWeD model of questioning was used to serve as a structural guide for the interview process.[10,11]

Questions included:

(1) *What do we see in this picture?*
(2) *What is really happening?*
(3) *How can this information be used to help others?*
(4) *Why does this problem or strength exist?*
(5) *What can be done about this situation?*

The interviewer also probed deeper on statements that had significant meaning as they emerged, and the interview format remained flexible and responsive to facilitate deeper understanding. As an agricultural producer herself, the evaluator was able to relate to AgrAbility clients' farm experiences and ask for clarification on tasks such as cattle handling and pasture rotation. This knowledge allowed for a more thorough understanding of the clients' lived experiences.

Following the phone interviews, the research team examined pictures, interview notes, and the captions that clients developed to explain their photos. These items were hand coded using an inductive process to allow the voices of the AgrAbility clients guide the project. Next, statements that added significant meaning to the evaluation and helped tell the story of the participants' perception of the AgrAbility program were highlighted, and these meaningful statements were transformed into themes. The research team then looked for connections in and among the themes and adapted them throughout the project as appropriate. The final themes identified in this process included independence, adaptation, accomplishment/satisfaction, social support, sharing your story, practical assistance, and jumping through hoops. Lastly, these themes were inserted into the appropriate levels of the socio-ecological model framework, where there is complex interaction between the individual and environment.

Findings

To protect the identities of AgrAbility clients, each client was assigned a pseudonym. Mary was a young woman in her late 30s who was hit by a drunk driver several years ago and left with severe injuries and limited mobility. Mary explained that her "condition will continue to deteriorate." John, who was in his 60s and the most recently enrolled AgrAbility client in this sample, was paralyzed after surgery to remove a cancerous tumor. He was undergoing radiation treatments at the time of the interview. Sam, a middle-aged male with severely limited vision, has been involved with AgrAbility since 1987. The results obtained from this evaluation should not be generalized to other programs and settings, but describe perspectives of the individual clients who participated in the Missouri AgrAbility PhotoVoice project.

Themes related to the individual

Independence

An important role of the Missouri AgrAbility program is to work with individuals with disabilities to help them maintain their independence on their farm or ranch. AgrAbility clients who participated in this evaluation had the desire to maintain as much of their lifestyle as they could, and were fearful about losing the rural way of life that they knew. Mary, who was eager to share once she learned the evaluator was also a cattle producer, explained, "Raising cattle is just in me…you know? I thought to myself [after the accident], What if I can't do this anymore?"

Adaptation

Through the help of the AgrAbility program, Mary was able to adapt her daily chore routine by using a Polaris Ranger with a gravity flow grain feeder attached to drive down to the troughs and feed calves. The Polaris allowed her to feed without the risk of being knocked over or stepped on. She submitted a picture of herself using the Ranger to feed cattle and explained, "The Polaris keeps me out of harms' way at all times and saves the amount of steps I need to take each day because I only have so many I can take." As part of the program, staff members conduct on-farm assessments to identify such adaptations that can make farming easier and safer for AgrAbility clients like Mary.

All of the clients involved in this project needed to modify their farming operations to some extent to adapt to their new realities. For example, Sam sent a picture of himself preparing to open a gap to turn cows onto fresh pasture and explained,

> Since 2008 I have been converting my livestock operation to a managed grazing system with the goal of putting myself out of the hay baling business. AgrAbility helped me map out water crossings so that I could access all parts of my acreage without driving on the highway.

Sam, who had originally farmed with his dad, had impaired vision. When Sam's father passed away, he adapted by raising more sheep and cattle on his farm in place of row crops and hay (which had required extensive tractor work and thus, better vision).

Accomplishment and satisfaction

The ability to perform activities that many take for granted, even in a modified form, was a positive impact of AgrAbility. John, who recently became a wheelchair user, explained that it felt good to get out of the house and to the barn lot, adding, "I really can't do much chores, but you feel like you're doing something that way." Mary also explained, "My pride hurts sometimes; it is a slow process to figure out how to do things". Farming is an important part of AgrAbility clients' identities, and contributing to life and work on the farm provides them with a sense of accomplishment and satisfaction.

Themes related to social support

Farm and ranch families are unique, because daily farm work is embedded in the family, or family is embedded in daily work on the farm; it is hard to distinguish which is which. When an individual becomes disabled, farm life and family life, which are intertwined in a complicated web, are greatly impacted. Even when a farmer is unable to work, livestock still must be fed and crops must be harvested. Management of the farm operation can be a particular challenge when a farmer faces chronic health concerns or a disability. An individual who has made his or her living as a farmer may suddenly have to depend on a multitude of immediate and extended family members, friends, and neighbors who alter their lives to help with his operation. For example, one AgrAbility client explained that his wife had to quit her job in town so she could help take care of the farm and care for him.

Clients involved in this project received social support, not only from family members, but also friends and neighbors. John told about friends from his church constructing a "makeshift shower" in his basement because he was unable to access the main floor in the wheelchair. The wheelchair he used was borrowed from a cousin of an extended family member. This support from friends and neighbors was critical for John during this early stage while he worked through the necessary steps to receive support from organizations and agencies.

One of the photographs submitted by Sam demonstrated the importance of social support from a unique angle; whereas other participants discussed social support provided to them by others, Sam supplied evidence that he is providing social support himself by including a picture of himself and his son checking the electric fence together. He wrote,

> My son Chris is 9 years old. He has autism. Chris often goes with me when we check cattle. In this photo I am showing Chris how to check the fence with a voltage tester. My son has unique challenges. AgrAbility has helped me pursue a vocational lifestyle that is supportive to Chris' need for open spaces.

Sam perceived the AgrAbility program as making it possible for him to provide social support to his son.

Themes related to community

Sharing your story

While the Missouri AgrAbility program's intended audience is the individual and their families, this project suggests the program also affects the manner in which participants contribute to their communities, which is the third layer of the socio-ecological model. Some AgrAbility clients feel that the program has opened doors for them to be able to tell their stories and share what they have learned with others.

Sam shared,

> I really enjoy participating in ag functions and farmer panels that I found out about through AgrAbility. I've even gone to international workshops and talked to people. Being involved in panels gives you an

> opportunity to give back. And it helps you not feel so bad about your own situation when you see someone farming without the use of their legs.

Sam added that he had received a phone call after the workshop from a young farmer in another state who was also struggling with vision loss. Sam reported that he enjoyed talking to the young man on the phone and encouraged him to keep farming.

The youngest of the three participants, Mary created a blog where she shares about adaptations she made to basic farm tasks in order to perform them successfully and safely. She reported developing this blog after spending a great deal of time looking for this type of information after her accident. She explained that she quickly realized there was not much information out there to help farmers with disabilities learn how to adapt their chores. Mary is now a regular speaker at agriculture workshops and seminars around the state. She believes that AgrAbility gave her the confidence to move forward and connect with others in the agriculture industry.

Themes related to the institution/organization

Practical assistance

The Missouri AgrAbility program comes under the institutional/organizational layer of the socio-ecological model. Interviews with AgrAbility clients indicated that this program, and the services provided by it, was critical to them. Mary commented, "The AgrAbility staff just want to help me, and I could totally feel that. They just want to keep me doing what I love".

Clients mentioned that in addition to helping them access resources, the AgrAbility program provided them with practical assistance to do their work in a safer way. Mary continued, "Even without equipment, AgrAbility is helpful. The tips, and helping me think more creatively about how to do things…and more safely." Clients saw the problem solving assistance from experts in the areas of agriculture, health, and safety to be very beneficial.

However, each of the three AgrAbility clients voiced concerns that there were people in their community who need help who were unaware of the AgrAbility program. They felt others could benefit from the support the program has to offer. Mary explained that she originally learned about the program at an Extension event. Participants suggested making sure there are marketing materials in various county and state agriculture-related offices, but agree that word of mouth is the most powerful marketing strategy.

Themes related to policy

Jumping through hoops

Missouri AgrAbility clients shared policy-related concerns about their experiences with the AgrAbility program and other partner non-profit organizations including time and money. Clients felt that receiving financial support involved "jumping through hoops" and a great deal of waiting. They did, however, comment that Missouri AgrAbility staff helped them figure out what they needed to do to navigate these "hoops", which included paperwork, emails, and phone calls to provide information to health care providers and support agencies. Clients reported being frustrated and feeling helpless to do anything to speed up processes. However, Mary and Sam both mentioned that the help they received from support agencies was "worth the wait."

One client expressed reluctance to depend on what he referred to as "government programs" for support. John, the most recently disabled AgrAbility client stated, "I know it's government, but it sounds like it's really going to help". Accepting help can be a challenge for farmers and ranchers, who tend to consider themselves to be independent and self-reliant. John explained, "I know I need help. But I don't want AgrAbility to do more than I need. I want to do as much as I can." Although John had the desire to be as independent as possible, it seemed he was willing to accept help from AgrAbility and other supporting agencies, because he was in a position where he perceived it as really necessary.

Conclusion, implications, and recommendations

This study contributes to a body of literature that emphasizes the importance for individuals with disabilities to maintain their farm and ranch

lifestyle. Clients talk about how living and contributing to work on their farms and ranches helps them feel more like themselves. These comments parallel Reed's 2004 study with farmers with upper-extremity amputations, where study participants stated that "real recovery" happened for them when they were back working on the farm again.[12]

This PhotoVoice evaluation allows us to understand that AgrAbility clients were fiercely committed to staying as independent as possible while adapting the way they operate their farms and ranches to maintain their rural lifestyles. Clients placed great value on the adaptive tools and technology the AgrAbility program helped them obtain.

One sign of the importance of this adaptive technology to the AgrAbility clients was found in their photographs. While they were asked to *take photos*, both of the clients who participated *asked someone else to photograph them doing a job on the farm*. Both Mary and Sam submitted photographs showing themselves continuing work in their farming operating by using an adaptive or assistive device. This choice may suggest that AgrAbility clients saw the identification and procurement of technology and devices that allowed them to continue to farm as one of the key functions of the AgrAbility program. Other researchers have also confirmed that technology helps to equalize opportunities that allow farmers to continue to be involved in the farming operation in prior studies.[13,14]

Comments from AgrAbility clients indicated that social support from spouses and immediate family members, friends, and neighbors was essential, particularly in accomplishing the jobs on the farm that have to be done in order for the business to survive. These perspectives align with previous studies that indicated farmers' injuries affect the entire family, particularly spouses who often take over more farm responsibilities[13] and that help from community members is critical if the farming operation is going to survive.[15]

AgrAbility clients said that the practical, on-farm assistance they received from the AgrAbility program helped keep them working, and they understood getting the help they need takes time. Although they reported that waiting for resources can be frustrating, they said getting the assistance they needed was worth the wait, and they knew AgrAbility staff were doing everything they could to help them continue farming and ranching in ways that are safe. This is in great contrast to perceptions of other farmers and ranchers have regarding health care professionals. According to previous studies that involved farmers with amputations, these farmers sometimes perceived that health care professionals created barriers to stop them from returning to farm work, because those in health care settings may believe farm labor is too physically taxing.[12,13] It seems that AgrAbility staff see the return to the farm and ranch vocation as an important part of clients' well- being.

Viewing results of the PhotoVoice evaluation using a socio-ecological model illustrates the ways the individual, social, community, organizational, and policy levels of the model interact with and depend on one another. AgrAbility clients do not live their lives in an isolated fashion. Rather, they interact across multiple levels of the socio-ecological model. The results of this small study indicate that the AgrAbility program helps to create positive environmental conditions in all layers of the socio-ecological model that support and promote effective change for farmer and rancher clients.

AgrAbility clients' photographs, captions, and interviews suggest that the Missouri AgrAbility program is fulfilling its purpose and contributing to client resiliency by addressing the individual, social, community, organizational, and policy levels of the socio-ecological model. When the results of this PhotoVoice evaluation are viewed alongside the McGill Pre- and Post-Quality of Life surveys, AgrAbility staff can see a clearer picture of how AgrAbility clients perceive and make meaning of their world.

Recommendations for program improvement include identifying ways to market the AgrAbility program in places where farm families go to do business, such as feed stores, grain elevators, banks, or crop insurance offices. Clients believed there are many individuals in the state who are unaware of the services AgrAbility offers. Suggesting other organizations and programs that can help build social support systems to current AgrAbility clients may also be valuable in helping farmers, ranchers, and their families address complex issues surrounding disability and

agriculture. In the future, the AgrAbility program may benefit from longitudinal evaluation work with a larger sample size, tracking clients for a number of years to determine long-term impact of AgrAbility on their lives.

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